INTERNATIONAL

MARINE ENGINEERING

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A Challenge

AT this time a year ago, when the first vessel was launched from the Newark Bay Shipyard of the Submarine Boat Corporation, the great Government assembling yards for building so-called fabricated ships were just beginning to add their quota to the production of vessels in the United States. The *Agawam* was launched on May 30, 1918, and, during the twelve months since that date, the Submarine Boat Corporation has launched no less than fifty-two vessels, representing a deadweight tonnage of 278,000. The launching of an average of one ship a week during the year establishes, the builders believe, a world's record.

Can any other shipyard in this country, or abroad, produce a launching record which will equal or better that made by the Submarine Boat Corporation?

Ban on Foreign Contracts Removed

THE delayed action of President Wilson in rescinding the order which prevented American shipbuilders from taking foreign contracts disposes of at least one obstacle, which has made the immediate outlook for business in some of the shipyards rather gloomy. Six months ago, numerous inquiries from foreign shipowners indicated that several maritime nations were eagerly seeking an opportunity to build up their merchant fleets, which had been seriously depleted by the war. More recently this demand has fallen off, owing to the fact that orders could not be placed in American yards, but now that American yards which are not fully occupied with Government work may take foreign contracts, it is probable that a considerable volume of business will be offered, provided prices and deliveries are acceptable. While most of the larger American yards will not be in a position to take foreign business until next year, nevertheless, many of the smaller yards can offer shipbuilding facilities at once, and it is estimated that possibly two million tons could be handled without disarranging the Government programme.

Planning for the Future

WITH the opening of Congress a resolution has been introduced in the House of Representatives by the new chairman of the Committee on Merchant Marine and Fisheries calling for an investigation into the operations of the Shipping Board and the Emergency Fleet Corporation and the preparation at the earliest possible moment of such legislation as may be found advantageous, and necessary to promote the advancement of the American merchant marine. This is a step in the right direction. Until some definite marine policy is established, little progress can be made in the broad development of shipping interests. The chairman of the Shipping Board has already stated his opinion as to a feasible method of developing the merchant marine, which, while not faultless, has nevertheless served as a useful basis for starting an exhaustive discussion of the subject. Other opinions from individuals and representative organizations have been freely offered, and just as this issue goes to press a conference of shipping, shipbuilding, exporting, manufacturing and allied interests is about to be held in Washington to consider the future policy for operating the merchant marine. Bearing in mind that the time is at hand not only to plan, but to act, these activities should soon lead to the establishment of a definite workable plan, by which the American merchant marine can take its rightful place in the world's commerce.

A Momemtous Shipping Deal

AFTER months of extended negotiations, the directors of the International Mercantile Marine last month approved the sale of the vessels and assets of its British subsidiaries to a British syndicate at a price said to be approximately $130,000,000 (£27,000,000). As it is believed that the approval of the stockholders of the company will naturally follow at a special meeting to be held this month, this action is regarded as closing the biggest deal in the history of American shipping. Stripped of its British tonnage, which included the fleets of the White Star, Atlantic Transport, Leyland, International Navigation and other lines, totaling 763,837 gross tons, the International Mercantile Marine will have as basis for future development a fleet of eleven vessels, totaling 130,641 gross tons, and the enormous sum made available by the sale of the British ships. With the resources created by the Government during the war to draw from, consisting of millions of tons of new American ships, and the most extensive shipbuilding facilities in the world, the International Mercantile Marine, with its experience and resources, will be in a position to enter the new era of American shipping in a way which opens up vast possibilities for the future of the American merchant marine.

British Shipbuilding Far Behind American

LLOYD'S shipbuilding returns for the first quarter of 1919 show that the amount of merchant shipping under construction in the United States is twice that in the United Kingdom. The total amount under construction at the end of March in allied and neutral countries, is given by Lloyd's as 7,796,266 tons. Of this, Great Britain's share is 2,254,845 tons as compared with 4,185,523 tons in the United States. The tonnage under construction in the United States constitutes 75 percent of the total tonnage building outside the United Kingdom.

Comparing the above figures with the returns for June, 1914—the last quarterly period before the war—it will be found that, while figures for the United Kingdom have

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been increased by about 500,000 tons, the tonnage building elsewhere has increased by more than four million tons. In reality, this increase is greater than would appear from the figures, as Germany and Austria were included in the earlier figures and not in the latter. As a matter of fact, the tonnage now under construction in the United States is more than twenty-eight times the amount under construction in June, 1914.

In spite of the relatively small increase in tonnage under construction in Great Britain, as compared with the pre-war period, shipbuilding conditions in Great Britain are considered favorable. British construction at present includes 603 steel steamers of 2,220,816 tons, besides 39 ferro-concrete barges, 1 motor vessel and 49 steel sailing ships. The number of large vessels under construction is considered a particularly favorable sign: 4 are between 10,000 and 12,000 tons; 8 between 12,000 and 15,000 tons; 6 between 15,000 and 20,000 tons, and 4 between 20,000 and 25,000 tons.

Following Great Britain, which stands second in the volume of merchant tonnage under construction, comes the British Dominions with 303,000 tons, Japan with 255,000 tons, Holland with 182,000 tons, and four other countries with over 100,000 tons each.

Marine Draftsmen's Convention

THE eighth annual convention of the American Society of Marine Draftsmen, will be held at the Hotel Brunswick, Boston, Mass., on June 20 and 21. Arrangements for the convention are in the hands of the Boston branch of the society.

Since this society was organized in Philadelphia, seven years ago, it has enjoyed a rapid and successful growth, and branches of the society are now located at all the prominent shipyards and navy yards throughout the country. With such a strong organization established for professional purposes, it is rather surprising that a part at least of its annual convention is not given over to the discussion of papers on professional subjects. It is true that lectures and discussions on engineering topics have a place in the regular monthly meetings of the branches of the society, and valuable articles on marine engineering and allied subjects are published in the journal of the society, but it would seem that the position of the society would be greatly strengthened if its annual convention were made the occasion for the reading and discussion of professional papers by its members.

More Officers Needed for Merchant Vessels

THE supply of first mates and first assistant engineers in the merchant marine is running short, according to reports from the Shipping Board, and attempts are being made to replenish the supply by promoting those in lower grades, who are entitled by experience to an advancement in rating. Second mates and second assistant engineers ambitious for promotion are urged by officials of the Shipping Board Recruiting Service to take an intensive course of study at the free schools for officers maintained by the Board. From two to four weeks in the classroom usually enables a merchant marine officer to qualify for a license in the next grade above. Over nine hundred students are now studying in these schools for their first licenses, and as many more are wanted who are qualified to try for advancement in grade. The schools are located at leading ports on the Atlantic and Pacific coasts, and on the Great Lakes.

LETTERS TO THE EDITOR

Performance of Geared Turbines

After close observation of the performance of the Westinghouse geared turbine installation in the *Agawam* for a period of three months, and covering a total distance of 9,866 miles, the results far exceeded my expectations. Like many other engineers of the old school, I was quite skeptical regarding the performance of geared turbines under adverse conditions, but I have had an opportunity to watch the performance of the entire installation under most trying conditions.

An outstanding factor of the geared drive in this vessel is its tendency to maintain a constant speed when the vessel is pitching badly. When battering through whole gales and mountainous seas, I observed less than 4 percent increase in revolutions with the vessel loaded, and less than 8 percent with the ship in ballast, the engine being governed entirely by the main governor valve, which controlled the speed in such a manner as to prevent any undue stress or laboring in the engine or gears.

The reduction gears had been severely galled previous to my taking charge of the engine department of the vessel, and it became necessary to run the galled gears after minor repairs, in order that the vessel might proceed on her errand of mercy with a cargo of valuable foodstuffs. I felt considerable anxiety regarding the gears and examined them at every opportunity. Each time I found a slight improvement, and after nearly 10,000 miles' service the gears were in first-class condition, considering their condition when starting the voyage, which I think speaks well for the floating I-beam construction.

No difficulty whatever has been experienced with the main engines, except sticking of the maneuvering valves and governors, which, in my opinion, was due entirely to salt and foreign matter carried over from the boilers, which had apparently been operated on salt water and fuel oil previous to my taking charge.

Like every other engine, the Westinghouse installation also has its disadvantages, among them being chiefly the "automatic gland control valve." This valve, although a well-designed mechanical device, is, in my opinion, far too delicate for successful operation under marine conditions.

New York. J. C. MEISLER,
Chief Engineer, S. S. *Agawam*.

Sea Captain Suggests Method of Operating Merchant Marine

Senator Ransdell, in his speech before Congress concerning the best way to handle the ships now controlled by the Shipping Board Emergency Fleet Corporation, gives nine different ways in which it is possible to handle these ships. Personally, the fifth proposition is the one I would favor; that is, chartering the ships on a time charter.

There is no question but that the Government is bound at first to suffer severe loss on the original cost of these ships. This is inevitable. If these vessels are, however, chartered on a time charter basis, the Government will receive all that the trade can carry, which is all that we ever can expect American shipping to get; that is to say, they will simply get paid what foreign ships will carry the same freight for. Under this time charter, the Government pays the crews' wages and the stores.

The writer believes that if this plan were carefully worked out on some such basis as the following, we would,

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in a very short space of time, have an efficient naval reserve for our fleet and also a more satisfied lot of seamen, for they would be under better discipline, better fed, and better cared for than the ordinary seamen:

1. The Government should see to it that these ships are manned absolutely by naval reserve men.

2. That these men are engaged on such terms as now hold in the Navy; that is, during their term of engagement they can be transferred from one ship to another.

3. That it be arranged that these men spend part of the year on a merchant vessel and part of the year on a man-of-war, or training ship.

Prior to the war, the chief officer of a tramp steamer in England never got leave. He would be out four to six months on a voyage, and when the vessel arrived in an English port his wife would probably go down and spend a week with him in that port. Such a thing as getting to his own home was out of the question.

If our vessels were manned by naval crews, the question of leave after a voyage, by simply transferring from one boat to another, could be arranged very easily; for the simple reason, that all of the crews would be under one management—the Government—instead of, as in England, the crews all being on separate ships with separate owners, and no one with whom to relieve the crews.

This is one of the causes for the tremendous "float" among seamen of the merchant marine. For instance, an officer on a tramp steamer getting no holidays, voyage after voyage, becomes dissatisfied and leaves his vessel so that he may have a few weeks at home. This immediately turns him into a "floater," because his next position as chief officer is with a new company and this practically kills his chance for a promotion. In fact, his only chance for promotion now is everlastingly to stick on the job and ignore the home life.

The greatest hardships of the old-time shipping were the food, quarters, lack of shore leave, and the general life of the seamen. If our merchant marine is handled absolutely by reserve men, or by naval men assigned to merchant ships, the life ought to prove very attractive to a great many young men. I believe, with Senator Ransdell, that the way these men are treated in the future will help to make life at sea attractive to them. The comfort of the *personnel* on the merchant vessel will have more to do with building up and holding the vessels we now have than any other feature.

CAPTAIN.

Future of the American Merchant Marine from Standpoint of Steamship Operator

BY O. C. CHAPMAN

The two major industries concerned with the future of the American merchant marine are shipping and shipbuilding. Hitherto most of the opinions published in these columns regarding methods of upbuilding the merchant marine have emanated from the ranks of the shipbuilders. In this article the problem is discussed from the standpoint of a practical steamship operator who has had extensive experience in both shipbuilding and ship operation. From this point of view the standard by which ideas and opinions are judged are their practicability, and the author makes a strong appeal for giving practical men full control and authority in establishing the merchant marine. Some of the most serious handicaps which must be contended with are the high wages paid for labor in both the building and operation of ships and the impractical provisions of the Seamen's Act, which must be revised. Obviously, such matters cannot wait, and shipowners must realize that now is the time not only to plan but to act.—THE EDITOR.

OUR country has always been full of optimists, which, in a way, accounts for the great results we have obtained in many of our industries and in our business conditions in general; but the greatest optimism in the world cannot overcome or remove impossibilities. With all due respect to the accomplishment as well as the flowery prophesied future of our American shipping business, a little constructive criticism may, in a way, help some of our very enthusiastic rooters to see that it is quite impossible to lift a platform while standing upon it. In other words, as far as our shipping prospects are concerned, there have stood for some time, and still stand to-day, barriers which practical men know cannot, without some revamping, be overcome. Experienced men are witnesses to the fact that when expenses are greater than the income there is no incentive for private enterprise.

Our laws and the labor conditions of the country determine the costs, while the revenue or income is what is secured by the transportation back and forth across the oceans, at a fair profit, of the merchandise of any nation. Our enthusiastic rooters and our prophets who are telling us of the grand, glowing future for our merchant marine without a change in laws, more economic conditions or a change in the attitude of labor, are inexperienced, impractical men, who have never seen their hard-earned dollars go down in competition with foreign shipping.

WHY THE OCEAN LINERS FLY FOREIGN FLAGS

Have you ever watched a magnificent steamer sailing down New York Bay with a foreign flag at her stern and wondered why an American flag was not there in the place of the foreign flag? Did you not notice in the appearance of that ship an atmosphere of prosperity and grandeur which made you wonder still more why it was a foreign ship instead of an American? There is a long story attached to this, but the real reason is that if that vessel were carrying an American flag, more good American dollars would have to go out in expense than could be returned in income. There would be loss instead of a profit at the end of each voyage, or, in other words, there is no money in it!

In getting at results the following conditions are in their own way the reasons why the outgo is greater than the income: Higher cost of construction; higher costs of

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operation; impractical and unprotecting laws; lack of government support; prejudice against shipowners by inland inhabitants; foreign interest in American railways and industries; lack of universal political interest in matters of the sea; political influence preponderating toward inland interest and several similar causes.

Our inexperienced superiors are declaring in strong terms all over the country (with the idea of getting the support of the sentimentally patriotic people, who, of course, mean well) that American talent and ability will overcome all difficulties. But this has not been borne out in practice—man for man, condition for condition, yes, but with all the above-enumerated conditions against him, no! The present condition of our merchant marine substantiates that these things cannot be overcome. Our present merchant marine may seem fine from a description or report of the Shipping Board, but the United States Treasury is behind that and we do not hear much of profits at any angle.

GOVERNMENT-OWNED MERCHANT MARINE IMPRACTICAL

A government-owned merchant marine will not, in anything like the same degree, build up our country as will a privately-owned merchant marine. In the first place, government-constructed ships in peace time require twice the length of time to build, about one-half as much more money and the result is not so satisfactory, as, when occasion arises for changes in the construction work, no one seems to have any authority or is able to act quickly in any matter, no matter how important. Privately owned steamers can be built for less money, more quickly, and more efficiently, to suit the trade than can any government ships. Why cannot the same be applied to the operations? If this is true, a private line of steamers could surely more efficiently compete with outside ships than Government-owned steamers.

We come to the application of the privately owned fleet to its work. In the first place we must look not at the present but some six or seven years hence, when ample tonnage of all nations to handle the vast shipping of the world has been constructed and rates are back to normal. Up to the present, from the best information I can get, not a single steamship organization operating in transatlantic or Pacific trade under the American flag has ever been a paying proposition. It may be that the Atlantic Transport Line, which was capably managed, made a profit, but at present I am unable to say. We have already noted the conditions which bring this state of affairs into effect. If there is a way to overcome them, why not find out our trouble and attempt to remedy it?

HIGH COST OF CONSTRUCTION AND OPERATION OF VESSELS

The cost of construction of vessels here has gone to $200 (41/13/4) per deadweight ton. Wages have been increased and labor has been granted its every whim in the ship line by the government. Costs of construction and repairs have gone to unheard-of proportions and relief is not in sight, for labor seems to have the whip hand, especially in the line of work controlled by the government.

If no way is found to overcome the excessive costs necessary to operate our merchant marine at a profit, it is hardly worth while to spend so much money on ships for foreign business. Government interference in private industry is always expensive and increases costs, so that it will shorten our troubles to get down to practical methods with practical business men and determine if it is possible to operate American ships in foreign trade profitably.

CAN AMERICAN SHIPS BE OPERATED IN FOREIGN TRADE PROFITABLY?

While it is true that foreign owners are trying to place orders for ships in American shipyards, even at the present high rates of construction costs, nevertheless it must be remembered that the foreign shipowners are very shrewd business men, and that just now the shipping rates will pay for the present high rates. The foreign owner, however, has two other points in view; one is that he cannot get ships abroad and he must have ships to keep his business going even if a loss is sustained. This will in a way prevent competition, and also the foreign ships which have to date been contracted for in American yards have been sold to American owners or others at greatly increased prices.

In trying to outline a plan for the success of the steamship business, we must for the moment lose track of the builder, for without the operator the builder will have nothing to do, and it is very evident that some of the ideals which now stand in the way will have to be removed. Labor conditions must come secondary to these things and rates must be brought to requisite levels. Patriotism will not support a family unless it is subsidized, and for the present we are trying to keep away from subsidy, although assistance along this line would cover a multitude of sins.

DREAMS WILL NOT SUPPORT AN OVERSEAS MERCHANT MARINE

Mr. Hurley asks us to give our undivided support to the merchant marine, and assures us that the merchant marine will take on a new era. He also asks us to study foreign countries and for the American youth to dream dreams of foreign countries and to cultivate the natural law of the sea. This is a fine idea, but, without all these things, we already know that with the present conditions it will require more than dreams and undivided support to put the overseas merchant marine of the United States on a paying basis. Is it better to pay wages and other expenses which are undue and exceptionally high and then ask the general taxpayer to pay into the government the cash necessary to pay out again to government employees, or even in subsidy (which may at any moment be cut down or done away with by political bosses), to make a profit on the operation of ships for either private or government-owned ships? Or is it better first to get costs and expenses down where they should be?

THE SEAMEN'S ACT A HANDICAP

Regarding the high cost of operation under the American flag, we are handicapped by the LaFollette law, which was put into operation by inexperienced and impractical men and which sickens and humiliates an operator or owner. No explanation of this is necessary to the practical man. Such laws should be framed and exacted by men of experience who are practical. The sailor signs a contract, but he has no idea of keeping it if he can do better by breaking it. He can break any agreement—and that is all there is to it—but the owner has to live up to his contract or suffer severe penalties. A sailor can hold up your ship, demand his money, take French leave, stop work if the cook does not suit him, charge overtime for anything he may do after schedule time, get drunk and cuss the officers and the law upholds him, or, in fact, makes it impossible to overcome these things without great delay, considerable expense and disheartening humiliation.

America, it seems, will emerge in a few years with about fourteen million deadweight tons of merchant ship-

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ping. The majority of the steel ships are supposed to be suitable for any service. The fabricated ship has as yet had no test upon its endurance qualities, but they are seaworthy, good bulky cargo carriers, and we are advised that they can be built considerably cheaper than the usual type of ship heretofore built. However that may be when many ships are being built, private owners do not order ships by the hundred. Usually the contract is for one or two ships. For my own use I would prefer the ship built in the old-fashioned way, which has always been reliable. However, it will no doubt be possible to get good service from all the steel ships we can get hold of for the next few years, but they cannot at present be operated at a profit under the American flag. If Shipping Board vessels could be sold to private owners at around $125 (26/0/10) a deadweight ton for the steel steamers, it would go a long way toward putting an American merchant marine on its feet.

Higher Wages Should Bring Better Service

In the operation of vessels, which will very soon be a very important American business, it may be possible to pay American seamen higher wages and compete successfully with foreign ships, but in doing so we must receive in return better results, better service, more efficiency per man. Are we doing this? Will we do this? When foreign shippers pay 50 cents (2/1) for a certain service, we cannot compete and pay $1 (4/2) for the same service. This means that our seamen and mechanics must for the increased rate give increased service. If they do not, we cannot operate vessels on the sea profitably in competition with foreign nations and pay any higher rates for first costs or for operating charges and wages. All who have to do with the construction and maintenance of ships well know this.

American Classification and Insurance Necessary

It is very necessary that American classification of American ships be effected. It is evident that owners would be benefited in more ways than one if they would arrange a mutual working agreement between themselves and our American Bureau of Shipping, which is fully competent to handle this work. This should be carried out with a view to enabling the owner to understand the importance of the classification bureau and the importance of having such matters fully American and co-operative.

The next in importance is the marine insurance, and there is no reason why all these policies should not be underwritten here, which in its turn will make more independent American operation, give better satisfaction, and with competent management will be more economical. Our shipowners, the classification bureau and the insurance people could by proper co-operation get a practical insurance system which would benefit the owners, the bankers and the general public. The classification and the insurance interests have no defective laws to hamper them or to prevent perfect conditions from being obtained along this line; and there is absolutely no reason why it should not be done, as our resources and capacity are fully equal to the occasion.

Now is the time for our shippers, vessels owners, shipbuilders and insurance men to work together to promote these essential branches on a practical basis. It can be done; there is no law handicapping this part of the programme, and there is money in it. We need practical men in every branch of the undertaking, and perfect results cannot be obtained unless practical men are given full control and all authority. We are then sure of the results and will not awake later to realize that we are on the wrong track.

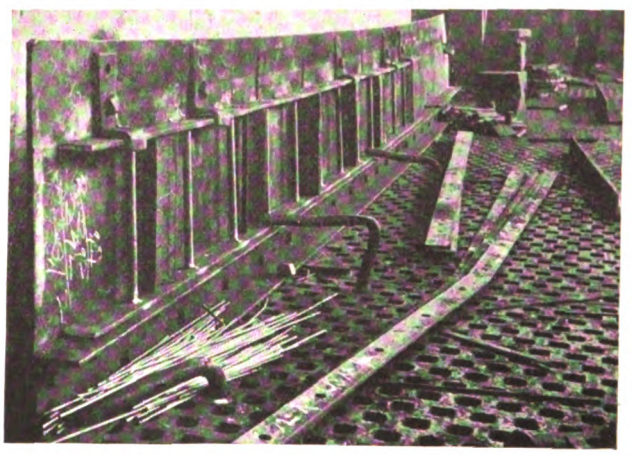
We are watching the building of our merchant marine; we are hoping that the very best results will be obtained. We expect to see the country from the Atlantic to the Pacific and from Canada to Mexico benefited by these things. Who will get a co-operative organization together and start the ball rolling and be satisfied to stomach the criticism that is bound to come? We all await further and better suggestions along these lines, and live in hopes that some attempts will be quickly made, not only to suggest but to act.

Handy Clamping Device Used in Manufacturing Ship Ladders

BY CHARLES C. PHELPS*

IT is common practice to weld the rungs to the sides of ship ladders by means of the oxy-acetylene blow pipe, resulting in exceptional rigidity of the structure. A convenient device for clamping the ladder while welding is in use at the shop of the Bethlehem Shipbuilding Corporation at Sparrow's Point, Md. The device consists of two channel bars between which is riveted a heavy steel plate, the latter in a vertical position.

One side bar of the ladder to be made is placed on the upper flange of one of the channels and held in position



Device for Holding Ladders While Welding Rungs with the Oxy-Acetylene Blowpipe

by means of dogs connecting with the bending floor. Vertical slots cut in the upper part of the vertical plate accommodate bolts which pass through the plate and secure several small clamps. These clamps hold the other side of the ladder in position and, by being adjustable, they can clamp ladders of various widths. Angle iron "clips," placed between the sides of the ladder, keep the ladder's width uniform throughout. The rungs are then dropped into position through the holes punched in the ladder side bars.

In welding with the oxy-acetylene blow pipe, first the tops of the rungs are welded to the outside of the upper side bar and the inside of the lower side bar is welded to the lower parts of the rungs, after which the ladder is unclamped and inverted so that the corresponding places on opposite sides of the ladder may be welded. Steel filling rod is used while welding, thereby insuring ample metal at the joints and a smooth finish.

* With Oxweld Acetylene Company, New York.

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	Where Built	Commenced	Launched	Completed
Royal Sovereign	Portsmouth	Jan., 1914	April, 1915	May, 1916
Royal Oak	Devonport	Jan., 1914	Nov., 1914	May, 1916
Revenge	Vickers	Dec., 1913	May, 1915	March, 1916
Resolution	Palmers	March, 1914	Jan., 1915	Dec., 1916
Ramillies	Beardmore	Nov., 1913	Sept., 1916	Oct., 1917

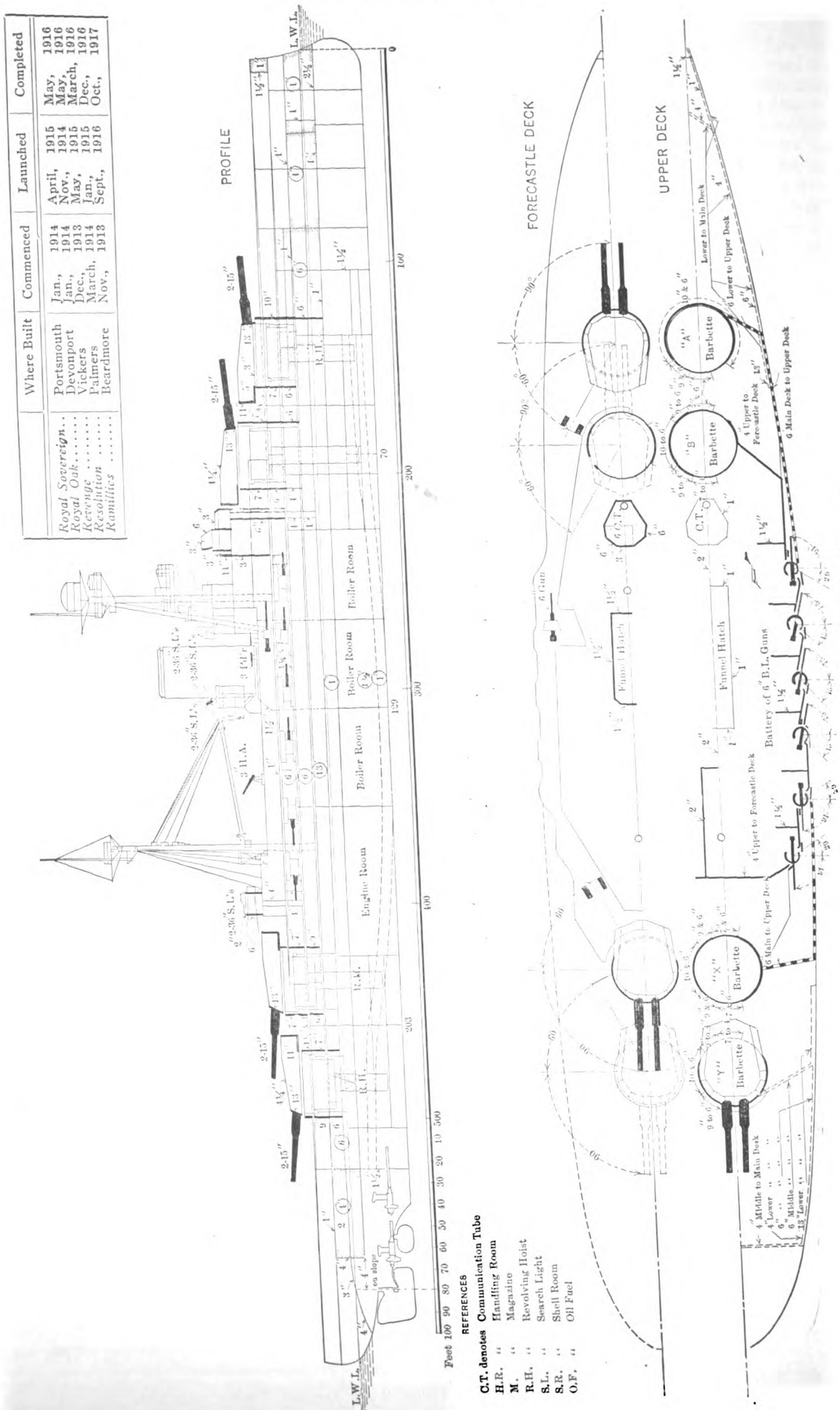

Fig. 1.—H. M. S. *Royal Sovereign* of the 1913-1914 Programme

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Naval Construction During the War*

Main Particulars of Naval Vessels Built for Great Britian From 1914 to 1918—Vessels Taken Over From Foreign Governments

BY SIR EUSTACE TENNYSON D'EYNCOURT, K.C.B.

IMMEDIATELY after war was declared, great pressure was exercised to complete the ship then building for the navy, and to order such other vessels as could be designed and finished in the shortest possible time. Generally speaking, therefore, the construction of new battleships was ruled out. With the acquisition of the *Agincourt, Erin* and *Canada,* which were building here for foreign governments in private yards, and bearing in mind the early completion of the remaining two vessels of the *Iron Duke* class, shortly to be followed by the vessels of the *Queen Elizabeth* class, we had a great preponderance of heavier capital ships, or *Dreadnoughts,* over the enemy; and as this class of ship takes longer to design and construct than any other, it was obviously a prudent course to concentrate on such types as were specially needed and could be built more quickly.

It should also be remembered that the menace of the submarine, which was from the first beginning to loom as a vital factor in the war, pointed in the direction of large numbers of patrol boats, torpedo-boat destroyers and smaller types of vessels to deal with this menace. No time, therefore, was lost in placing orders for additional destroyers, submarines, light cruisers, sloops, mine-sweepers, patrol boats, etc.; and it very soon became clear that the dockyards and the regular warship-building contractors would not be able to cope with the mass of new construction that was required.

Naval Vessels Built by Merchant Shipbuilders

Accordingly, orders for many of the last-named classes were placed with builders who had hitherto only been accustomed to mercantile work. With the arrangements that were made, however, for superintending and overseeing the work by the Admiralty, with the assistance of the registration societies—Lloyd's and the British Corporation—very little difficulty was experienced in getting the work satisfactorily carried out by the firms new to this class of shipbuilding, and I think the results show what success attended the arrangements made.

To take ships added to the navy during the war in the proper order, it is necessary to begin with battleships of the *Iron Duke* class. The particulars of all previous *Dreadnoughts* are pretty well known and have been published. The *Iron Duke* class, of which there were four, followed the *King George V* class both in sequence of time and in general characteristics. The same main armament, similarly arranged, with the five turrets all on the centerline of the ship, was adhered to, the chief difference in the *Iron Dukes* being that, instead of the 4-inch guns forming the secondary armament, a battery of twelve 6-inch guns protected by 6-inch armor was, after considerable discussion, finally decided upon. The protection also was somewhat increased over that of the *King George V,* involving an increase in dimensions over any of our previous battleships, due to the addition of these weights and of other items. Two of the class had been laid down in January, 1912, and two in May, the four vessels being completed in March, June, October and November, 1914, so that two were ready just before, and two shortly after, the declaration of war. Four torpedo tubes were carried in lieu of three in the previous ships, and after the battle of Jutland a considerable amount of additional protection was added over the magazines, a course which was practically adopted in all our ships at that time as a precautionary measure. Only in one case was any portion of a shell found to have penetrated below the protective deck; but with the ever-increasing range at which actions have been fought, and the increasing penetration of improved shell, the danger of the decks being inadequate had to be considered.

The tables appended give the general particulars of these ships and of all the others with which I am dealing in this paper. It should be mentioned, however, that the speed obtained on trial was approximately 22 knots, or about a knot in excess of the legend speed.

The "Iron Duke" Class

Special interest is attached to this class, as the *Iron Duke* was the fleet flagship during the whole time of Admiral Jellicoe's appointment as commander-in-chief, and she was in action at Jutland with her sister ships. The *Marlborough,* it should be specially noted, was the only British battleship of the post-*Dreadnought* type struck by a torpedo during the whole war, and the value of the longitudinal protective bulkhead and of the subdivision and arrangements adopted was clearly shown, as the ship was able to remain in the line, no vital damage being done. She was afterwards safely docked in the Tyne and repaired. This is, I think, specially interesting, as many of our older ships, some with centerline bulkheads and with other arrangements not so good for dealing with underwater damage, were sunk in the Dardanelles and elsewhere by enemy torpedoes.

1912-13 Programme

The next type to note is the *Queen Elizabeth* class of 1912-13 programme. Three of these vessels, after taking a little more than two years to build, were completed in January, March and October, 1915. The other two were completed in February, 1916. A very considerable departure was made in the *Queen Elizabeths* from any previous *Dreadnoughts,* the 15-inch gun taking the place of the 13.5-inch, and the designed speed being increased by 4 knots over our previous *Dreadnoughts,* while the secondary armament was similar to that of the *Iron Dukes,* consisting of 6-inch guns. Their very great increase of speed involved practically doubling the horsepower necessary to give the 25 knots desired, and the great increase in the weight of the 15-inch guns and mountings over the 13.5-inch meant accepting only four turrets with eight 15-inch guns, as against five turrets with ten 13.5-inch guns in our previous ships, and even so the armament was considerably heavier. The further great departure from previous practice in battleships was the adoption of oil only as the fuel. This necessitated special arrangements of the oil bunkers, many of which were 30 feet in height, and required special construction to withstand the head of oil. The armor and protection were fully maintained as compared with previous ships, but all these additions involved increasing the displacement to 27,500 tons.

In the battle of Jutland, the fifth battle squadron,

* From a paper read before the Institution of Naval Architects, London, April 9.

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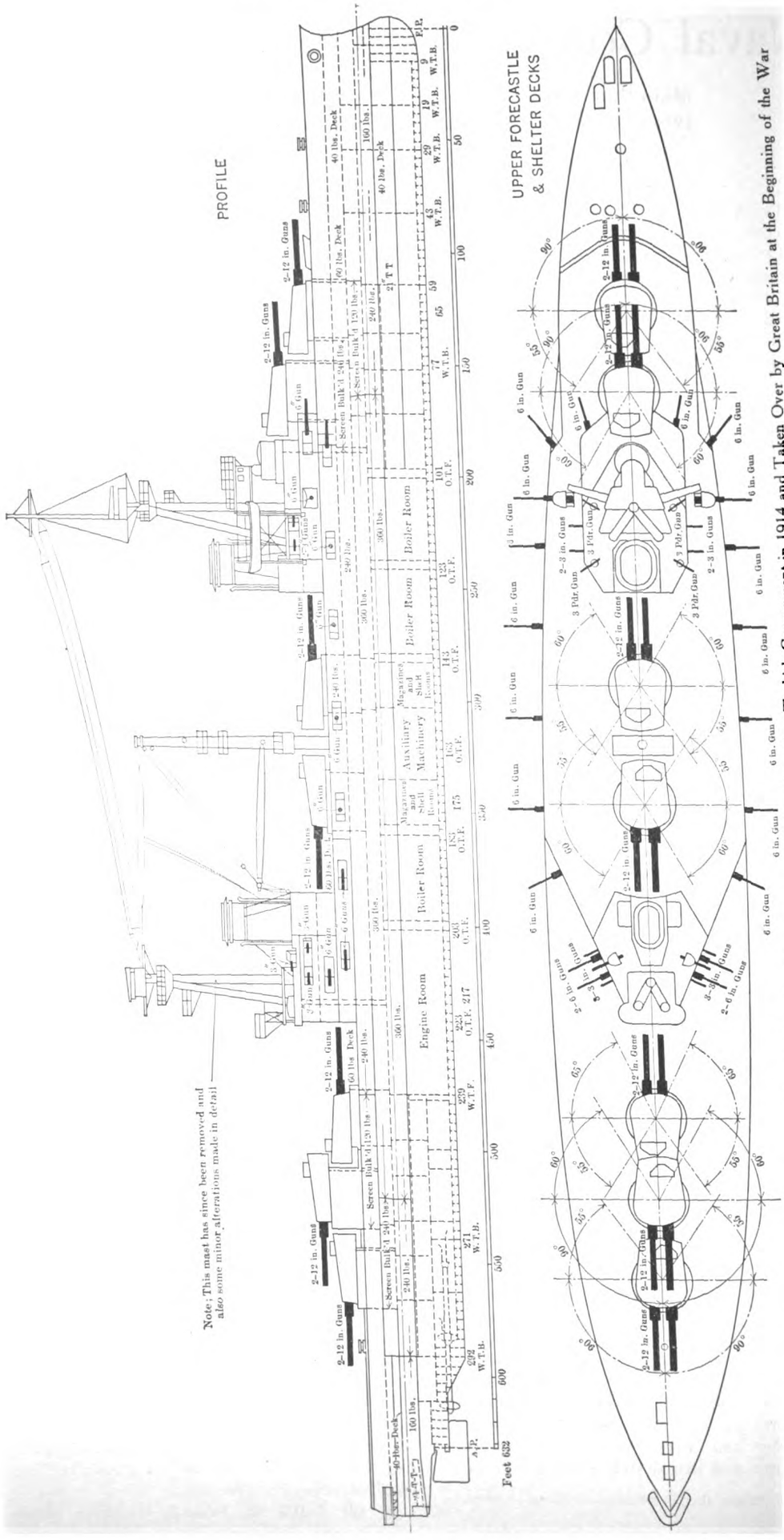

Fig. 2.—H. M. S. *Agincourt*, Originally Designed for the Brazilian Government, Transferred to the Turkish Government in 1914 and Taken Over by Great Britain at the Beginning of the War

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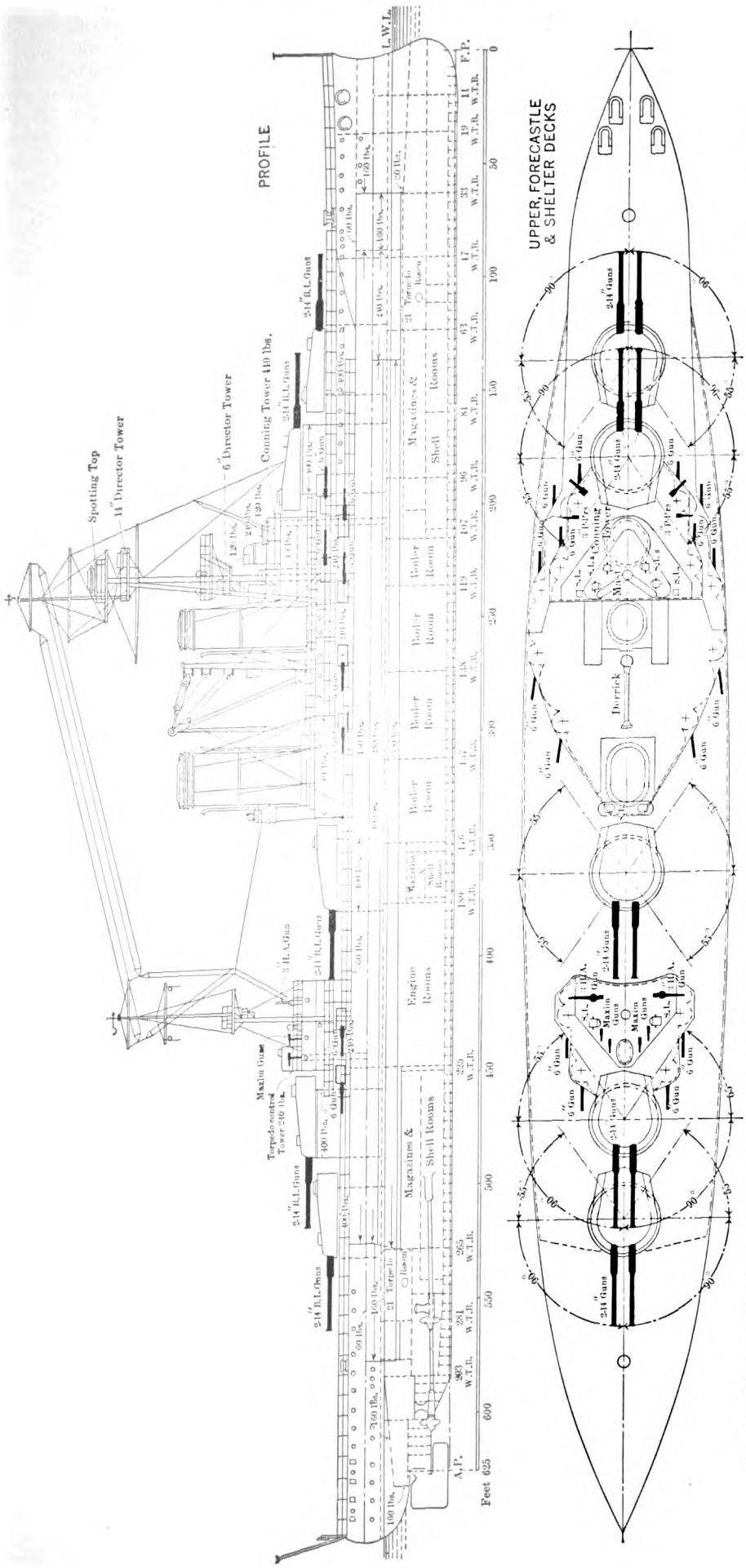

Fig. 3.—H. M. S. *Canada*, One of Two Sister Ships Laid Down in 1911 at Elswick for the Chilean Government, But Taken Over by the British Government During the War

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consisting of four vessels of this class were heavily engaged for several hours, and although they inflicted and sustained heavy punishment, especially in the case of *Warspite*, all the vessels gave a splendid account of themselves and were not seriously damaged or put out of action. After the battle of Jutland, additional protection was added to the magazines. It may be mentioned that the oil fuel proved a complete success, it being found easier to keep up a high sustained speed, and a smaller complement also is, of course, involved, as there is great saving in personnel as against that required for a coal ship.

I should mention that Sir Philip Watts was responsible for the design of the *Iron Duke* and *Queen Elizabeth* classes, thus completing a series of twenty-seven battleships of the *Dreadnought* class designed and built during his tenure of office at the Admiralty, in addition to the large number of battle cruisers and light cruisers and other vessels built during that period—truly a great record.

Battleships of the "Royal Sovereign" Class

The next in order came the *Royal Sovereign* class of the 1913-14 programme. These vessels were to have the same armament as the *Queen Elizabeth*, but, as there was some question about the supply of oil fuel when the design was discussed, it was decided to revert to coal, and also to accept the slower speed of 21 knots, which would make them more homogeneous with other *Dreadnoughts*. Subsequently, when the vessels were in process of construction and the great advantages of the use of oil fuel with other types of warships became apparent, it was decided to change from coal to oil, and it was anticipated that increased power giving a speed of about 23 knots would be obtained. As a matter of fact, when fully laden with about 4,000 tons of oil, the *Revenge* attained 22 knots, which was equal to about 23 knots in the designed load condition. A different disposition of deck and side armor was also adopted by which the thick protective deck at the center of the ship was brought up to the level of the main deck, this portion of the protective deck being well above the level of the deep load line, and giving more protected freeboard in the damaged condition than in any of our earlier battleships. This was an important feature, as a somewhat reduced metacentric height was decided upon for these ships with a view to making them steadier gun platforms than some of the ships with larger G. M. The vessel was provided with good underwater protection, which in certain of the ships was further reinforced by adding outside bulge protection. This was done to *Ramillies* before her launch and also to two other vessels of the class after they had been in commission some time, during refit, and it is proposed to add the bulge to the remaining two ships of the class when opportunity offers.

The addition of bulges was suggested by myself originally for the *Edgar* class, for which I designed this form of protection in 1914, after considerable experiments had been made. The results have proved the efficiency of the bulges.

Battleships Taken Over from Foreign Governments

The three ships taken over from foreign governments were of different types, as shown in the table of particulars.

H. M. S. *Agincourt* was commenced in September, 1911, for the Brazilian Government, when I took out various designs (got out under Mr. Perrett at Elswick) to Rio de Janeiro and finally settled on the design of the *Agincourt*, after modifying it very considerably on the spot. The Brazilian authorities, after much discussion, decided upon fourteen 12-inch guns, twin-mounted in seven turrets. This involved a ship with a length of 630 feet between perpendiculars and 670 feet over all. The main armor was somewhat lighter than our British *Dreadnoughts* (as seen from the particulars attached), and in other respects, such as fueling facilities, the ship hardly came up to the British standard. However, she was well reported on and the fourteen big guns were liked by the gunnery officers, who preferred a large number of guns for their salvoes. Certain alterations had to be made to fit her for our service, but in the main she was left as designed.

I should perhaps mention that in 1914 she was transferred from the Brazilian Government to the Turkish Government, and when war broke out she was on the point of leaving for Constantinople, when she was taken over.

The design of the *Erin* was settled by the three firms, Armstrongs, Vickers and John Brown, in consultation with the Turkish authorities, for whom the vessel was built, being commenced in November, 1911. In general characteristics she more nearly followed the *King George V* class than any other British ship, except that the secondary armament consisted of 6-inch guns, as in the *Iron Duke* class. This vessel also was taken over by the British Government in August, 1914, and certain modifications made to fit her for the British service. In respect of quantity of fuel carried, the *Erin* was below the standard adopted for vessels designed for the British navy.

The third ship taken over from a foreign government was ordered and commenced in 1911 at Elswick from designs prepared by Mr. Perrett for the Chilean Government. There were two ships of the class, the *Almirante Latorre* (now the *Canada*) and the sister ship the *Almirante Cochrane* (now the *Eagle*). The *Canada* has ten 14-inch guns, twin-mounted, in the centerline, and was originally designed to have twenty-two 4.7-inch as the secondary battery, but this was subsequently altered to sixteen 6-inch guns. The protection again was somewhat lighter than that of our own *Dreadnoughts*, but the speed was rather higher, viz., 22¾ knots, and as a matter of fact this speed was considerably exceeded on trial. The ship was taken over by the British Admiralty in September, 1914, and completed, after certain necessary modifications, a year later. Her fuel consisted of coal, with the addition of a certain amount of oil, as in most of our battleships.

The sister ship, *Almirante Cochrane*, remained in an uncompleted condition on the stocks at Elswick till the spring of 1917, when she was taken over by the British Government and rearranged as an aircraft-carrying ship. She was renamed H. M. S. *Eagle*, and, as a compliment to the United States Navy, she was, at the request of the Admiralty, launched by Mrs. Page, the wife of the late American Ambassador.

The above record finishes the list of battleships proper which were completed for service during the war.

Large Battle-Cruisers

Coming to the battle-cruisers, particulars have already been published of all these down to H. M. S. *Tiger*. This ship was included in the 1911-12 programme and followed on the *Queen Mary*, the general features of the two ships being much alike, the chief differences being that the secondary armament of *Tiger* is twelve 6-inch guns in lieu of sixteen 4-inch in *Queen Mary*, and *Tiger* has two submerged torpedo rooms, whereas *Queen Mary* had only one.

After the design was approved by the Board, the ship was ordered and laid down at Clydebank on June 12, 1912, and completed in October, 1914. In common with so many of our ships completed during the war, the early commissioning and joining of the fleet was so imperative that

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no exhaustive trials in deep water were carried out, but the runs made on the Polperro Course showed that the designed power of 108,000 shaft horsepower could be obtained with little difficulty, corresponding to a speed of 30 knots. During the progress of the design, the oil fuel capacity was very largely increased in case of need; the

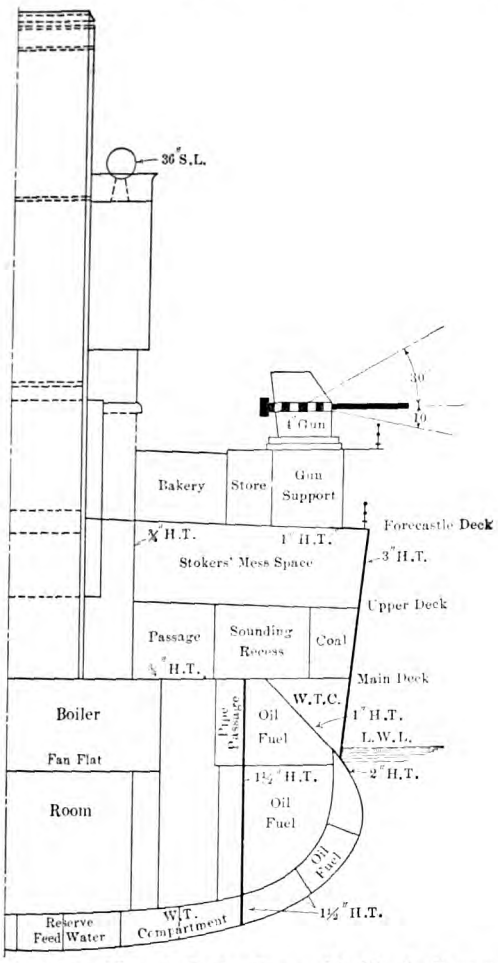

Fig. 6.—Section Through Boiler Room, H. M. S. *Courageous*

original tanks, which only allowed for 1,100 tons, were supplemented to admit a maximum oil stowage of 3,480 tons, in addition to the 3,320 tons of coal; but it is not usual for the vessel to carry this full fuel stowage—at any rate, of oil.

BATTLE-CRUISERS "RENOWN" AND "REPULSE"

At the commencement of the war, two additional battleships of slightly modified *Royal Sovereign* type, viz., the *Renown* and *Repulse,* had been laid down, but in view of the long time it would take to complete these ships the construction was not pressed forward. Immediately after the battle of the Falkland Islands, in which our battle-cruisers *Invincible* and *Inflexible,* in company with other smaller cruisers, annihilated Von Spee's fleet, the value of the battle-cruiser type became very apparent, and on the initiative of Lord Fisher, then First Sea Lord, it was decided to stop the construction of *Renown* and *Repulse* as battleships and to alter the design completely into that of very fast battle-cruisers.

I received instructions to re-design these ships about Christmas, 1914. The new design had to give a speed of 32 knots, with the largest number of guns possible for such a vessel, and with protection similar to the *Invincible* and *Indefatigable* classes. A modified form of bulge was adopted in these ships to give additional underwater protection against torpedo attack. Proposals are now under way for still further adding to this bulge protection.

The general outline design was completed and approved in ten days, and six 15-inch guns adopted as the main armament, the secondary armament consisting of seventeen 4-inch guns, of which fifteen were mounted in five specially designed triple gun mountings. Owing to the circumstances referred to above, it was necessary that the ships should be completed at the earliest possible date, and I suggested that *Tiger's* machinery should be repeated with some additional boilers, and with the extra length it was found possible to obtain the speed of 32 knots, as laid down by the Board. Lord Fisher also insisted that the ships must be completed within fifteen months—an abnormally short time for an entirely new design, without

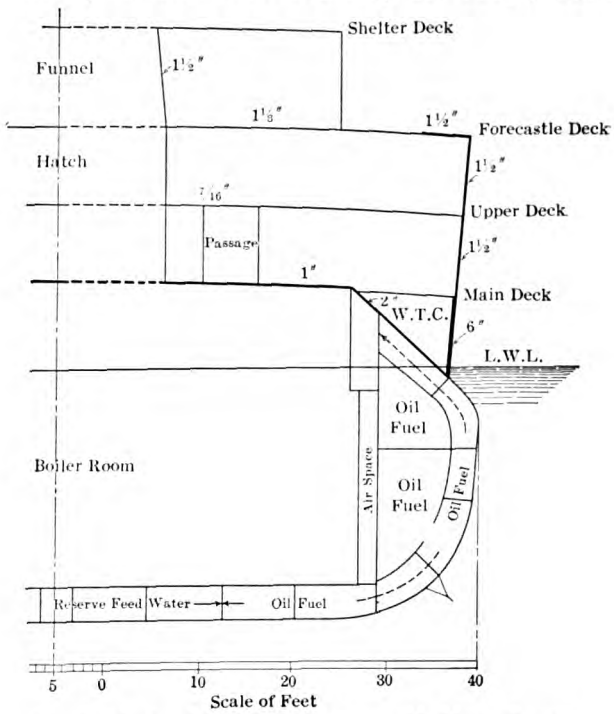

Fig. 7.—Section Through Boiler Room, H. M. S. *Repulse*

any drawings prepared. This period of completion was not realized, although not greatly exceeded.

By January 21, 1915, the two firms entrusted with the orders, viz., Messrs. John Brown and Fairfield, were supplied with sufficient information to enable them to proceed with the structure, and both keels were laid on January 25. All the drawings and specifications were completed by April and the design finally approved in that month. The fuel was to be entirely oil, and with the additional boilers the power expected to be from 110,000 to 120,000 shaft horsepower, the latter having actually been obtained on trial.

Repulse was launched in January, 1916, less than a year from the laying down, and the *Renown* was launched three months later. *Repulse* went through her commissioning trials early in August, and *Renown* followed one month later and was completed in September.

The speed of *Repulse* on trial was over 31¼ knots in the deep condition, and the *Renown* obtained 32.6 knots mean speed on the new measured course off Arran in the normal condition.

The ships have been well reported upon at sea and maintain their speed well.

I think that the construction of these vessels in a little over one and a half years from the first order to get out

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TABLE I.—DIMENSIONS OF TYPES OF BRITISH WARSHIPS BUILT DURING THE WAR

	Battleships						Battle Cruisers		Large Light Cruisers		
	Iron Duke	*Queen Elizabeth*	*Royal Sovereign*	*Agincourt*	*Erin*	*Canada*	*Tiger*	*Renown*	*Courageous*	*Furious*	
Length between perpendiculars	580 ft. 0 in.	600 ft. 0 in.	580 ft. 0 in.	632 ft. 0 in.	525 ft. 0 in.	625 ft. 0 in.	660 ft. 0 in.	750 ft. 0 in.	735 ft. 0 in.	750 ft. 0 in.	
Length overall	622 ft. 9 in.	643 ft. 9 in.	624 ft. 3 in.	671 ft. 6 in.	559 ft. 6 in.	661 ft. 0 in.	704 ft. 0 in.	794 ft. 0 in.	786 ft. 3 in.	786 ft. 6 in.	
Breadth, extreme	90 ft. 0 in.	90 ft. 6 in.	88 ft. 6 in.	89 ft. 0 in.	91 ft. 7 in.	92 ft. 0 in.	90 ft. 6 in.	90 ft. 0 in.	81 ft. 0 in.	88 ft. 0 in.	
Load draft, mean	28 ft. 0 in.	28 ft. 9 in.	28 ft. 6 in.	27 ft. 0 in.	28 ft. 6 in.	28 ft. 6 in.	28 ft. 6 in.	25 ft. 6 in.	22 ft. 3 in.	21 ft. 6 in.	
Displacement in tons	25,000	27,500	25,750	27,500	23,000	28,000	28,500	26,500	18,600	19,100	
Shaft horsepower of engines	29,000	75,000	40,000	34,000	26,500	37,000	108,000	112,000	90,000	90,000	
Speed at load draft (knots)	21	25	23	22	21	22¼	30	32 nearly	32	31½	
Fuel at load draft (tons)	900	650	900	1,500	900	1,150	900	1,000	750	750	
Coal capacity (tons)	3,250	.....	.....	3,200	2,120	3,300	3,320	.....	.....	.....	
Oil fuel capacity (tons)	1,050	3,400	3,400	620	710	520	3,480	4,250	3,250	3,400	
Armament	10 13.5 in. 12 6 in. 4 21 in. T.T.	8 15 in. 12 6 in. 4 21 in. T.T.	8 15 in. 14 6 in. 4 21 in. T.T.	14 12 in. 20 6 in. 2 21 in. T.T.	10 13.5 in. 16 6 in. 4 21 in. T.T.	10 14 in. 14 6 in. 4 21 in. T.T.	8 13.5 in. 12 6 in. 4 21 in. T.T.	6 15 in. 17 4 in. 2 21 in. T.T.	4 15 in. 18 4 in. 14 21 in. T.T.	10 5.5 in. 18 21 in. T.T.	Particulars of Light Cruisers, Monitors, Destroyers, T.B.D. Flotilla Leaders, Patrol Boats, Sloops, Paddle and Twin-screw Mine-sweepers, and "China" Gunboats are given overleaf.
Armor—Side, amidships	12 in. 9 in. 8 in.	13 in. 6 in.	13 in., 6 in.	9 in., 6 in.	12 in. 9 in. 8 in.	9 in. 7 in. 4½ in.	9 in., 6 in., 5 in.	6 in., 1½ in.	3 in.	3 in.	
Side, forward and aft	6 in., 4 in.	6 in., 4 in.	6 in., 4 in.	6 in., 4 in.	6 in., 4 in.	6 in., 4 in.	4 in., 2 in.	4 in., 3 in.	2 in. forward	2 in. forward	
Bulkheads, forward and aft	8 in. 6 in. 4 in.	6 in., 4 in.	6 in., 4 in.	6 in., 3 in.	8 in.,5 in., 4 in.	4½ in., 4 in.	9 in. to 3 in.	7 in. to 4 in.	3 in., 2 in.	3 in., 2 in.	
Barbettes	10 in. to 3 in.	10 in. to 4 in.	10 in. to 4 in.	9 in. to 3 in.	10 in. to 3 in.	10 in. to 4 in.	9 in.	11 in. to 7 in.	7 in. to 3 in.	7 in. to 3 in.	
Gunhouses	11 in.	11 in.	11 in.	12 in., 8 in.	11 in.	10 in.	10 in.	10 in.	9 in., 7 in.	7 in.	
Conning tower	11 in.	11 in.	11 in., 6 in.	12 in.	12 in.	11 in.			10 in.	10 in.	
Protection—Vertical plating	1½ in. 1 in.	2 in. 1 in.	1½ in., 1 in.	1½ in. 1 in.	1½ in.	2 in., 1½ in.	2½ in., 1½ in., 1 in.	1½ in.	1½ in., 1 in.	1 in.	
Forecastle deck	1 in. amidships	1 in.	1 in.	1½ in. amidships	1½ in. amidsh.	1 in. amidships	1½ in., 1 in.	1½ in.,1⅛ in.	1 in.	1 in.	
Upper "	2 in. to 1¼ in.	2 in. to 1¼ in.	1½ in. to 1¼ in.	1½ in.	1½ in.	1½ in.	1½ in., 1 in.	½ in.	1¼ in., ¾ in.	1¼ in., ¾ in.	
Main "	1½ in. at ends	1¼ in. at ends	2 in. 1½ in. 1 in.	1½ in. 1 in. at ends	1½ in.	1½ in. att	1 in. at ends	3 in. to 1 in.	.....	.....	
Middle "	2½ in. 1 in.	1 in. amidships	2 in. slope main to middle	1½ in. 1 in.	3 in., 1 in.	1 in.	.....	.....	3 in., 1 in.	3 in., 1 in.	
Lower "	2½ in. 1 in.	3 in. 1 in.	1 in. 2½ in. 3 in. 4 in.	2½ in. 1 in.	.....	4 in. 2 in.	3 in., 1 in.	2½ in.			

	Submarines					
	"*E*" Class	"*G*" Class	"*H*" Class	"*J*" Class	"*K*" Class	"*L*" Class
Length between perpendiculars	180 ft. 0 in.	185 ft. 0 in.	164 ft. 6 in	270 ft. 0 in.	334 ft. 0 in.	222 ft. 0 in.
Length overall	181 ft. 0 in.	187 ft. 0 in.	171 ft. 0 in.	275 ft. 0 in.	338 ft. 0 in.	231 ft. 0 in.
Breadth, extreme	22 ft. 6 in.	22 ft. 6 in.	15 ft. 9 in.	23 ft. 0 in.	26 ft. 6 in.	23 ft. 6 in.
Load draft, mean	12 ft. 6 in.	13 ft. 3 in.	11 ft. 3 in.	14 ft. 0 in.	16 ft. 0 in.	13 ft. 6 in.
Displacement in tons, surface	660	700	440	1,210	1,880	890
Displacement in tons, submerged	800	975	500	1,820	2,650	1,070
Shaft horsepower of engines, surface	1,600	1,600	480	3,600	10,000	2,400
Shaft horsepower of engines submerged	840	840	320	3,150	1,400	1,600
Speed at load draft (knots), surface	15	14	13	19	24	17¼
Speed at load draft submerged	10	10	10½	9½	9	10½
Oil fuel capacity (tons)	45	44	16	91	200	76
Armament	1-3 in. 5-18 in. T.T.	1-3 in. 4-18 in. 1-21 in. T.T.	4-21 in. T.T.	1-3 in. or 4 in. 6-18 in. T.T.	1-4 in. 1-3 in. H.A. -18 in. T.T. 8	1-3 in. or 4 in. 6-18 in. T.T.

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	Light Cruisers				Monitors						
	Arethusa	*Calliope*	"*D*" Class	*Raleigh*	*Humber*	14-in. Gun Class	12-in. Gun Class	*Marshal Soult*	*Ere'bus*	9.2-in. Gun Class	6-in. Gun Class
Length between perpendiculars	410 ft. 0 in.	420 ft. 0 in.	445 ft. 0 in.	565 ft. 0 in.	261 ft. 6 in.	320 ft. 0 in.	320 ft. 0 in.	340 ft. 0 in.	380 ft. 0 in.	170 ft. 0 in.	170 ft. 0 in.
Length overall	436 ft. 0 in.	446 ft. 0 in.	471 ft. 0 in.	605 ft. 0 in	266 ft. 9 in.	334 ft. 6 in.	335 ft. 6 in.	355 ft. 8 in.	405 ft. 0 in.	177 ft. 0 in.	177 ft. 0 in.
Breadth, extreme	39 ft 0 in.	41 ft. 6 in.	46 ft. 0 in.	65 ft. 0 in.	49 ft. 0 in.	90 ft. 0 in.	87 ft. 0 in.	90 ft. 3 in.	88 ft. 0 in.	31 ft. 0 in.	31 ft. 0 in.
Load draft, mean	13 ft. 6 in.	13 ft. 6 in.	14 ft. 3 in.	17 ft. 3 in.	4 ft. 9 in.	10 ft. 0 in.	10 ft. 0 in.	10 ft. 3 in.	11 ft. 0 in.	6 ft. 0 in.	4 ft. 0 in.
Displacement in tons	3,500	3,750	4,650	9,750	1,260	6,150	5,900	6,670	8,000	540	355
Shaft horsepower of engines	40,000	40,000	40,000	60,000	1,450	2,000	2,300 to 2,500	1,500	6,000	480 to 800	400
Speed at load draft (knots)	29	29	29	30	12	6 to 7	6 to 7	6 to 7	12	12 to 13	10
Fuel at load draft (tons)	260	300	300	1,000	50	200	200	100	220	....	....
Coal capacity (tons)	....	....	....	800	187	400	350	....	....	....	....
Oil fuel capacity (tons)	810	920	1,050	1,600	90	....	....	235	750	30	45
Armament	2 6 in. 7 4in. (1H.A. 8 21 in. T.T.	2 6 in. 8 4 in. 4 21 in. T.T.	6 6 in. 2 3 in. H.A. 12 21 in. T.T.	7 7.5 in. 12 3 in. (4 H.A.) 6 21 in. T.T	3-6 in. 2 4.7 in. Howitzers	2 14 in. 1 6 in.	2 12 in. 1 to 4 6 in.	2 15 in. 8 4 in.	2 15 in. 8 4 in.	1 9.2 in. 1 3 in.	2 6 in. 1 6-pounder
Armor—Side, amidships	3 in.	3 in.	3 in.	3 in. 2 in.	....	....	....	....	....	....	....
Side, forward and aft	2 in., 1½ in.	2 in. 1½ in.	2 in., 1¾ in., 1½ in.	2½ in., 1½ in.	....	....	....	....	....	....	....
Bulkheads, fore and aft	....	....	1 in. aft.	1 in. aft	....	....	....	....	....	....	....
Barbettes	....	....	....	....	....	4 in.	6 in.	4 in.	4 in.	....	....
Gunhouses	....	....	....	....	....	8 in. to 2 in.	8 in. to 2 in.	8 in.	8 in.	....	....
Conning tower	6 in.	6 in.	....	3 in.	....	10 in., 7 in., 4 in.	10½ in., 5½ in., 4 in., 2 in.	13 in., 11 in., 4¼ in.	13 in., 11 in., 4¼ in.	....	....
Protection—Vertical plating	....	....	....	....	....	6 in.	6 in.	6 in.	6 in.	....	....
Forecastle deck	....	....	....	....	....	1½ in.	1 in.	1 in.	1 in.	....	....
Upper "	1 in. amidships	1 in. amidships	1 in. amidships	1 in. amidships	....	1 in.	1 in.	1 in.	1 in.	....	....
Main "	....	....	....	....	....	2 in. to 4 in. on slope	2 in. to 6 in. on slope	1½ in., 2 in. to 4 in. on slope	2 in. to 4 in. on slope	....	....
Lower "	1 in. aft	1 in. aft	1 in. aft	1 in. aft	....	1½in., 1 in.	1½ in., 1 in.	1½ in., 1 in.	1½ in., 1 in.	....	....
					....	....	....	....	....	....	....

	Torpedo-Boat Destroyers			T.B.D. Flotilla Leaders		Patrol Boats	Sloops and Mine-sweepers			"China" Gunboats	
	"*M*" Class	"*R*" and "*S*" Classes	"*V*" and "*W*" Classes	*Kempenfelt* Class.	*Scott* Class and *Shakespeare* Class (approx. same).	"*P*" Class.	Single-screw Sloops "*Flower*" Class	Paddle Mine-sweepers	Twin-screw Mine-sweepers	"*Fly*" Class	"*Insect*" Class
Length between perpendiculars	265 ft. 0 in.	265 ft. 0 in.	300 ft. 0 in.	315 ft. 0 in.	320 ft. 0 in.	230 ft. 0 in.	255 ft. 3 in.	235 ft. 0 in.	220 ft. 0 in.	120 ft. 0 in.	230 ft. 0 in.
Length overall	273 ft. 4 in.	276 ft. 0 in.	312 ft. 0 in.	325 ft. 0 in.	332 ft. 6 in.	244 ft. 6 in.	267 ft. 9 in.	245 ft. 9 in.	231 ft. 0 in.	126 ft. 0 in.	237 ft. 6 in.
Breadth, extreme	26 ft. 8 in.	26 ft. 8 in.	29 ft. 6 in.	31 ft. 9 in.	31 ft. 9 in.	23 ft. 9 in.	33 ft. 6 in.	29 ft. 0 in. (58 ft. ov'r pad'les)	28 ft. 0 in.	20 ft. 0 in.	36 ft. 0 in.
Load draft, mean	8 ft. 8 in.	9 ft. 0 in.	9 ft. 0 in.	10 ft. 0 in.	10 ft. 6 in.	7 ft. 7 in.	11 ft. 0 in.	6 ft. 9 in.	7 ft. 0 in.	2 ft. 0 in.	4 ft. 0 in.
Displacement in tons	1,025	1,065	1,300	1,650	1,800	573	1,250	810	750	98	645
Shaft horsepower of engines	25,000	27,000	27,000	36 000	40,000 to 44,000	4,000	2,400	1,400	1,800	175	2,000
Speed at load draft (knots)	34	36	34	34	36	22	17	15	16	10	14
Fuel at load draft (tons)	140	150	185	255	250	50	130	....	....	....	....
Coal capacity (tons)	....	....	....	....	....	....	260	150	140	5	35
Oil fuel capacity (tons)	280	300	370	515	500	93	....	....	....	10	54
Armament	3 4 in. 1 2-pounder 4 21 in. T.T.	3 4 in. 1 2-pounder 4 21 in. T.T.	4 4 in. or 4.7 in. 1 3 in. 4 or 6 21 in. T.T.	4 4-in. 2 2-pounders 4 21 in. T.T.	5 4.7 in. 1 3 in. H.A. 6 21 in. T.T.	1 4 in. 1 2-pounder 2 14 in. T.T.	2 4 in. or 4.7 in. 2 3-pounders	1 3 in. 1 6-pdr. 2 2-pdrs.	1 3 in. 1 6-pd r. 2 2-pdrs.	1 4 in. 1 3 in. 1 6-pdr.	2 6 in. 2 3 in. ....

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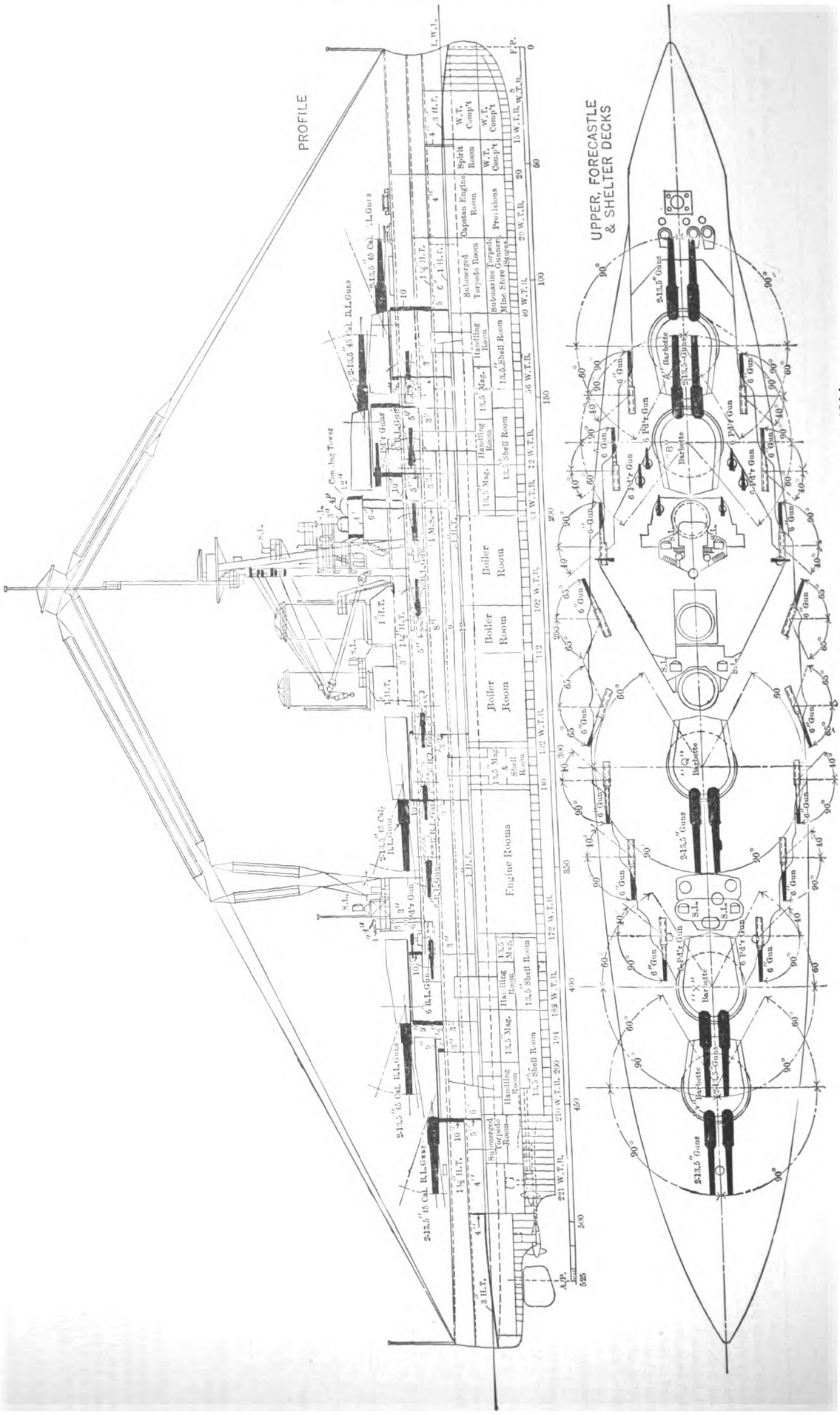

Fig. 8.—H. M. S. *Erin*, Taken Over from the Turkish Government by Great Britain in 1914

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the design constitutes a record in design and construction of two such important vessels and reflects great credit, not only upon the Royal Corps of Naval Constructors, but also upon the contractors and all concerned in the construction and completion of the vessels. In fact, the Admiralty conveyed their appreciation of this to me in a letter dated September, 1916.

LARGE LIGHT CRUISERS "COURAGEOUS," "GLORIOUS" AND "FURIOUS"

While the designs of *Renown* and *Repulse* were in progress, I received instructions to design some very high-speed ships carrying powerful guns of a size sufficient to keep their speed in moderate weather, but to have a draft lighter than any existing British or enemy ship of the same class, so as to be able to navigate shallow waters, if required.

As sanction was not likely to be obtained for building more capital ships taking two years or longer to complete, while additional light cruisers had been already approved of, it was decided to build *Courageous* and *Glorious* on the lines of very large light cruisers mounting a few guns of heaviest calibre, so as to be able to annihilate any enemy light cruisers or raiders. They were to have thin protection, similar to our light cruisers, and a speed of not less than 32 knots, the draft being restricted to about 22 feet, or about 5 feet less than any existing battleship or battle-cruiser carrying such heavy guns, the main armament of four 15-inch guns in two turrets, one forward and one aft, making them a match for any raider or light cruiser that might be encountered. At this time it should also be remembered that the armaments of ships, especially as regards heavy guns, had to be regulated by the guns and gun-mountings which would be available or could be manufactured in the time at our disposal, and this condition applied to the 15-inch mountings which were adopted for these ships. The secondary armament consisted of eighteen 4-inch guns in six triple mountings, similar to the triple mountings of the *Renown* and *Repulse*. The side armor consisted of 2-inch protected plating on top of the 1-inch shell plating, as in our light cruisers, and a thin protective deck was worked all fore and aft, but this was considerably thickened over the magazines after Jutland. A modified bulge was arranged for, as in *Renown* and *Repulse*.

The machinery adopted for these ships was of the type fitted in the light cruiser *Champion*. It consisted of a 4-shaft arrangement of geared turbines, the power being transmitted to the propeller shafts by double helical gearing. The eighteen boilers of Yarrow small tube type were also similar to those of the light cruisers, and with all-oil firing a power of 90,000 shaft horsepower at about 340 revolutions was aimed at. Such trials as it was possible to make showed that 32 knots could easily be obtained at the designed displacement, and reports show that on service this is actually exceeded.

The design of these vessels was begun late in January, 1915, and the order for one ship (*Courageous*) was placed with Messrs. Armstrong and the other (*Glorious*) with Harland & Wolff, the latter making their own machinery and Messrs. Parsons supplying the machinery for Messrs. Armstrong's ship.

It was intended that these vessels should be built in a year, or as near that as possible, but this was not realized, and the ships were both commissioned in October, 1916.

On her commissioning trials, the *Courageous* worked up to full power, and while steaming during the trials at full speed she met very heavy weather. Some signs of weakness were shown at the fore side of the forward turret, where there is an inevitable discontinuity of longitudinal strength, and some doubling plates were accordingly added to the *Courageous*. Her sister vessel *Glorious* was in commission for over a year before similar additions were made to her, although no signs of weakness were shown. This incident shows that the very high speed obtained on trial, reaching 32 knots, should hardly be maintained against head seas in heavy weather.

The *Furious* was similar to, but a modification of, the *Courageous* and *Glorious*, having about the same length and the same machinery, but the form of midship section was somewhat different, having a more pronounced bulge and a simpler form of main framing and structure of the hull. The armament also was different, each turret, instead of having two 15-inch guns, was arranged to carry one big gun of 18-inch bore, although arrangements were made to substitute pairs of 15-inch guns, if thought desirable later.

The order for this ship was placed with Messrs. Armstrong about two months after that of *Courageous*, and she was to be finished in the shortest possible time. Early in the spring of 1917, however, the necessity for having fast aeroplane-carriers became very obvious, and it was approved to fit *Furious* for this purpose. This entailed doing away altogether with the fore turret and making other considerable alterations. A large hangar was built on the forecastle deck, and a flying-off platform 160 feet long was arranged on the roof of the hangar, which was designed to house about ten machines. Later it was decided to remove the after turret as well, and a flying-on deck 300 feet long, extending from the funnel aft, was constructed.

The secondary armament, which had consisted originally of eleven 5½-inch guns, was retained, with the exception of one gun, the remaining ten guns being rearranged. Four sets of triple 21-inch torpedo tubes were fitted on the upper deck aft, and one pair each side on the upper deck forward.

After these alterations were completed, the ship was tried and commissioned in July, 1917, a speed of 31½ knots being obtained with 94,000 shaft horsepower at 330 revolutions.

(To be continued.)

New Regulations Approved by Steamboat-Inspection Service

On March 22, 1919, the Board of Supervising Inspectors, Steamboat-Inspection Service, adjourned, having convened in annual meeting on January 15, 1919.

During the meeting the Board announced the rules and regulations relating to line-carrying projectiles and the means of propelling them, life lines for lifeboats, and approved the Hall line-carrying gun, which action was published in circular letters. The Board further amended rules relating to boilers and attachments, life-saving appliances, licensing of officers of vessels, and other rules, and approved various kinds of life-saving appliances, fire apparatus and pipe boilers.

The action taken on all of the subjects above referred to will shortly be published in a circular letter with title of "Eighteenth Supplement to General Rules and Regulations," which will be furnished steamboat companies, boiler manufacturers and others concerned. When ready for distribution, the circular letter can be obtained from any board of local inspectors, Steamboat-Inspection Service.

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SHIPPING POSSIBILITIES OF THE YANGTSE KIANG RIVER

(For Description of Vessel Shown Below, See Page 396)

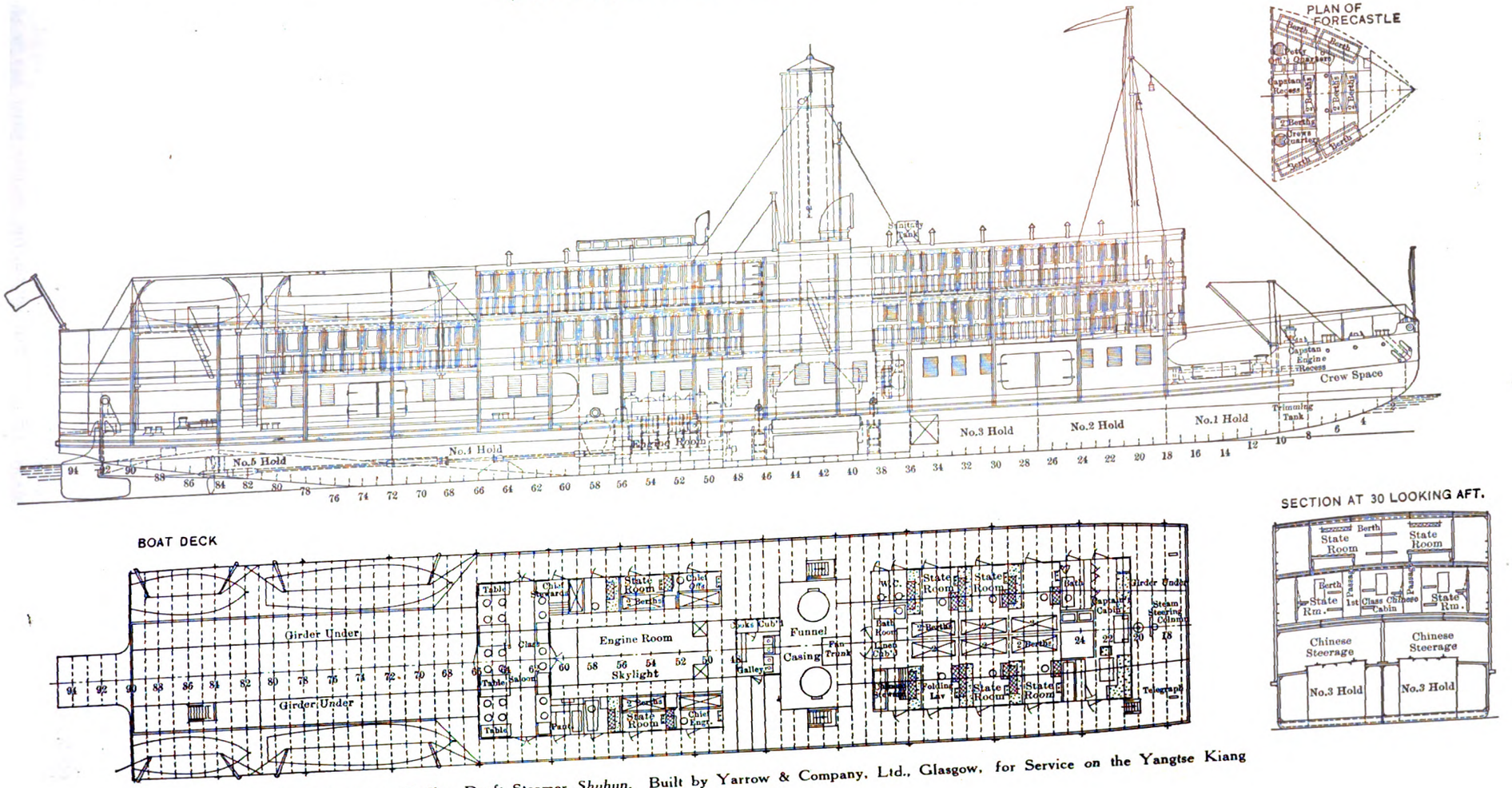

Fig. 1.—Twin-Screw Shallow-Draft Steamer *Shuhun*. Built by Yarrow & Company, Ltd., Glasgow, for Service on the Yangtse Kiang

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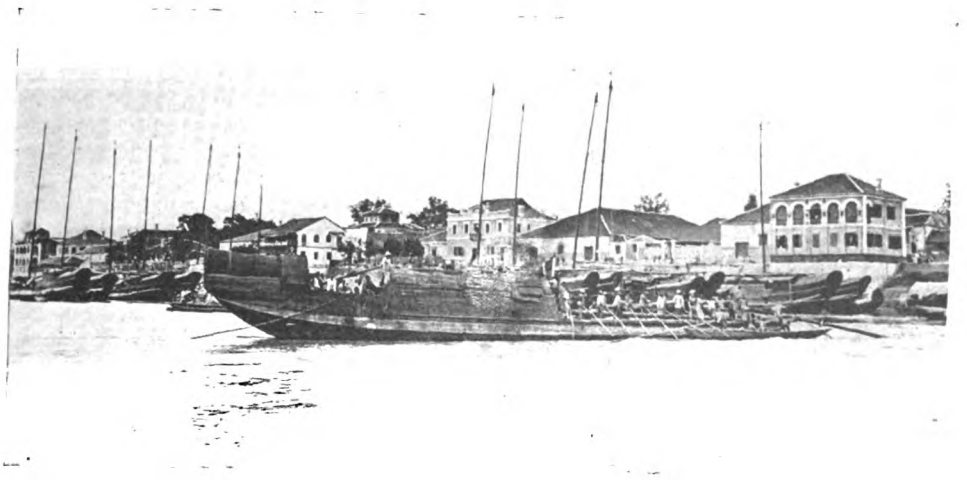

Fig. 2.—Upper Yangtse Junk

Shipping Possibilities of the Yangtse Kiang River

Naval Commander Discovers Unusual Opportunities for Profitable Shipping on Chinese River—Types of Vessels in Successful Operation

BY LIEUTENANT-COMMANDER H. DELANO, U. S. N.

THE United States gunboat *Palos* had hardly dropped anchor in the whirling waters of the Yangtse Kiang at the port of Ichang, China, one thousand miles from the coast, when the quartermaster-of-the-watch announced that the master of a Chinese merchant vessel wished to see the commanding officer. I expected to see a fat, well-fed native out of a job, who wanted to pilot the ship through the gorges and rapids to Chungking, whither the *Palos* was bound. Much to my surprise a keen-eyed, vigorous American appeared, who announced the fact that he was the last American skipper on the Yangtse.

The trip up river had been very tiresome; the weather was extremely hot; our coal was chiefly dirt, which made steaming difficult, and to add to our already numerous difficulties, every junk we met seemed bent on colliding with us, thereby causing us to steam miles out of our way to avoid them. So naturally all hands were tired and would have preferred turning in rather than entertaining a stranger. The first words of Captain Brown, as I shall call him, sounded promising; it was apparent that he needed no entertainment, so we lighted our pipes, got under the electric fans and listened to his story.

The Captain's Story

"For twenty-five years," Captain Brown began, "I have steamed up and down this river and along the coast. When I first came out I served as mate on a small coastwise steamer—rotten craft even in those days, but they flew the American flag, which helped some. The river business began to boom, so I came up here and got my own boat, a new one of the China Merchants Line. You've seen her—the stern-wheeler now on the Changsha run, modelled after Mississippi steamboats. When I came up river, Chinese steamers flew the American flag because American capital was invested. The only other foreign flag was British; the Japs hadn't horned in yet."

Captain Brown paused an instant for breath, then bringing his fist down upon the table with a bang, asserted, "There is money to be taken out of this river! The lower Yangtse lacks a lot of being crowded with shipping, while the upper river is as deserted as the Dead Sea. There is where a barrel of money can be made by a live American with sufficient capital to make a start."

Here Captain Brown hesitated long enough for me to interpose a question. "What," I asked, "is the reason why there is practically no shipping on the upper river when, as you state, a gold mine awaits the shipowner who operates up there?" The captain's reply was prompt. "The Chinese have filled the gorges with terrible traditions," he said. "Their tales make the rapids look like waterfalls to the folks living in the flat country. These people down here are bluffed, and that is all there is to it. The people who have the money listen to these tales and then duck. None of you officers has navigated the rapids, but you are going through in a few days. You don't look like you are going to a funeral, and your ship isn't built for the upper river, either. Look at the *Shuhun*. Paid for herself the first year and still running, making a mint of money for her owners every year and good for several years still.

"There is no doubt in my mind about the wonderful chances for an American shipping company on the upper Yangtse, and that is why I came to see you. I have thought this thing out and am trying to interest capital. I may have to go to the States for backing, but I am giving Americans out here the first chance. However, you people are probably tired, so I will not bother you to-night. Have tiffin with me on my boat to-morrow and I will explain my plans." The captain left the ship and we retired.

The Mission of the Palos

The *Palos* was en route to Chungking Szechwan, West China, her station for the winter. Her function was to

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"show the flag and to protect American interests." Four hundred cases of stores ranging from boxes of tinned tomatoes to bales of waste had been shipped to Ichang for transshipment to Chungking, and the first thing to do was to arrange for shipment to go forward. Early the following morning I set out to accomplish this. At this time—midsummer of 1916—four companies were operating steamers between Ichang and Chungking. The Teh Yeh Company operated one steamer, the Lien Hwa, 366 gross tonnage and 13 knots, flying the Jardine Matheson house flag, a British concern. This steamer made several trips, but, due to lack of boiler power, could not be relied upon for regular service.

The Szechwan Railway Company operated the steamer *Tachuen*, 250 gross tonnage, 13 knots. This steamer is

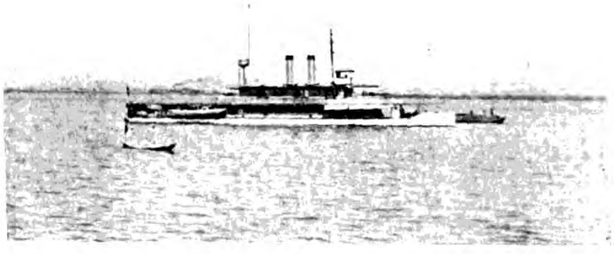

Fig. 3.—U. S. Gunboat *Palos*

still operating at a profit. Later in the year two additional steamers, the *Chu Chuen* and *Chi Chuen*, were put on the run. Their gross tonnage is 825, speed 11.5 knots; but they were under-boilered and could not make their designed speed, so were eventually laid up at Ichang.

The Szechwan Steam Navigating Company was the only successful operating Company. In 1909 this company began operating the *Shutung*, a small steamer of 37 registered tons, which towed a barge of 159 tons capacity alongside. The Shutung was built in England and was so successful that the Shuhun was laid down. This steamer was designed for a deadweight capacity of about 300 tons, with a speed of 14 knots.

Cargo Space on the River Boats at a Premium

Knowing the number of steamers supposedly in operation, I thought my task of obtaining cargo space would be fairly simple. I was soon disillusioned, for every agent had the same formula ready—"No space." We simply had to ship the stores, but even the extra inducement of a higher rate failed miserably. I thought of Captain Brown and his scheme and took a sampan out to his ship with considerably more interest than I had had the night before.

After a good lunch the captain unfolded his plans. "The *Shuhun* is the best boat on the upper Yangtse," he began; "she has plenty of speed and sufficient cargo space to turn over a nice profit at the end of each run. I propose to have two such steamers to start with, owned by an American company, flying the American flag. You failed to get cargo space because there are several thousand tons ahead of you. My steamers will help carry that tonnage.

"Examine these customs reports of last year," he continued, displaying voluminous reports of the year 1915; "see the amount of business carried on between Ichang and Chungking! Apply the prevailing freight rates and you can figure for yourself that my boats will pay for themselves the first year and turn out a good profit besides." Here the captain's pride asserted itself. "If Chinese," he said, "can operate steamers through the gorges and rapids, so can I." After talking for an hour or more, examining the data he had compiled, and discussing details of organization, I went away convinced.

Our stores had to be shipped, so I went ashore to make another attempt to obtain shipping space. Freight charges go to the company, but "cumshaw" does not; therefore, but one course was open. A few substantial presents judiciously bestowed resulted in placing 225 packages. Sixty packages measuring 102 cubic feet were billed out on the *Chu Chuen* at $1.00 U. S. C. per cubic foot. One hundred and twenty-five, 212.5 cubic feet, were billed out on the *Lien Hwa* at $1.05 U. S. C. per cubic foot. Forty packages, 68 cubic feet, were billed out on the *Shuhun* at $1.08 U. S. C. per cubic foot. The remaining 175 packages were billed out on two large junks at $.95 U. S. C. per cubic foot, and the following day started on their two-months' trip to Chungking. The total cost of shipments can readily be seen; but, high as it was, the commissioner of customs thought we were very fortunate to obtain space at all.

Possibilities for Shipping on the Upper Yangtse

The object of this article is to show American shipping men the possibilities that exist on the upper Yangtse. The resources of the country are practically untapped and will remain so until adequate transportation is available. The Szechwan Steam Navigation Company's steamers *Shutung* and *Shuhun* have made good. They have successfully navigated the waters of the turbulent river, through beautiful gorges and over strong rapids, for years. Yet even at present there is more freight awaiting shipment than the steamers now operating can handle. The *Shutung* is too small to constitute a good investment, but the *Shuhun* is well designed and represents the best type of steamer for this service, therefore a brief description of this vessel is given.

Twin-Screw, Tunnel-Stern Steamer Shuhun

The *Shuhun* was designed by Captain S. C. Plant, the premier navigator of the upper Yangtse, and was built by Yarrow & Company, Glasgow, in 1914 at a cost of $112,000, U. S. C. Captain Plant's aim was to obtain a

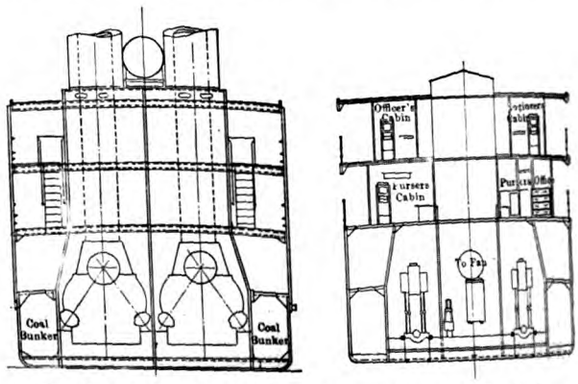

Fig. 4.—Sections Through Machinery Space of the *Shuhun*

vessel sufficiently powerful to negotiate the rapids under her own steam without the assistance of warping lines, and at the same time to be large enough to contain sufficient cargo space in order that it might operate at a profit.

The designs contemplated a length of 190 feet, beam of 30 feet, and a draft of 5 feet, with a full cargo load of 300 tons. Machinery was designed to develop 2,000 horsepower at a speed of 14 knots. While building, designs

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were altered somewhat, with resultant characteristics as follows: Length, 194 feet; beam, 30 feet 10 inches; draft under full loading, 5 feet 6 inches. The general features of design are fully shown on the plates reproduced by courtesy of *Engineering*, London, which published an article descriptive of the *Shuhun* in their issue of November 6, 1914.

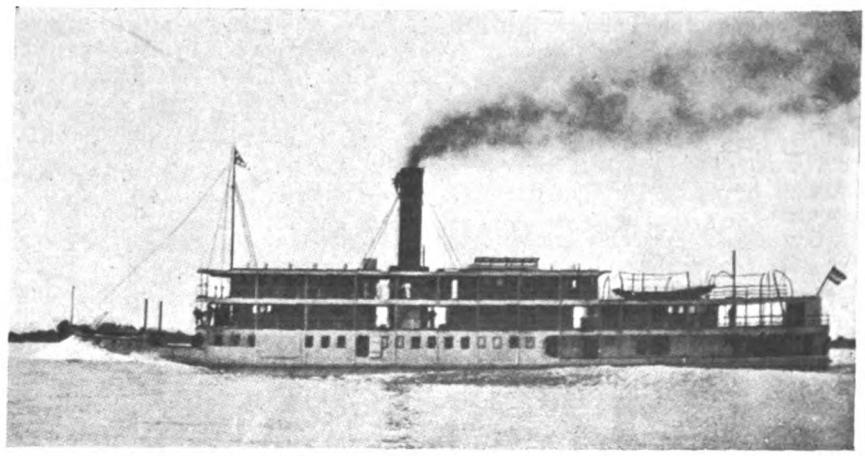

Fig. 5.—River Steamer *Shuhun*

The hull is divided into nineteen compartments by longitudinal and transverse bulkheads, fitted with watertight doors. There are four decks—main, upper, boat and awning. Accommodation for European passengers and the officers is on the boat deck and consists of a dining salon and eight 2-berth staterooms for passengers, also captain's, chief officer's and chief engineer's cabins, pantry, galley, bathrooms and toilets, and steward's cabin. Chinese first and second class passengers are quartered on the upper deck, the quarters consisting of a first class dining salon and eight first class, 2-berth staterooms, a second class salon and eleven 4-berth staterooms, purser's cabin and office and assistant purser's cabin. On the main deck there are accommodations for 170 native steerage passengers, fifteen firemen and three engineers. In actual service, however, means have been found for the accommodation of 300 steerage passengers. In the forecastle there are accommodations for four petty officers and twelve men, also a mess room for fourteen cooks and boys.

Propelling Machinery

The propelling machinery consists of two vertical inverted triple-expansion engines designed to develop 2,000 horsepower at 14 knots. Two double-ended watertube coal-burning boilers are installed. On account of the necessity for quick increase of speed to full power, oil fuel may be used in conjunction with coal. In practice, however, the use of oil has been found unnecessary.

The propellers work in tunnels, the after ends of which may be partially or wholly closed by hinged flaps. The flaps work automatically, so that at all conditions of displacement and draft they are always in the most efficient position.

In order to preclude the possibility of the vessel being deflected from its course when entering a rapid, also to provide sufficient rudder area for proper steering when steaming through swirls and whirlpools, three balanced rudders actuated by hand and steam power are provided. There are two steam steering stations, one on the upper bridge and one in the wheelhouse. The hand steering station is also in the wheel house. The steam steering engine is located in the engine room. With both engines working at half power, the vessel turns within two lengths.

There are five separate cargo holds having a total capacity of 16,000 cubic feet, and on a draft of 5 feet the vessel has a deadweight capacity of 300 tons. The vessel is lighted throughout by electricity, current being supplied by an oil-driven dynamo.

An Opportunity for American Shipping

The only means by which merchandise may be taken out of the provinces of Hupeh and Szechwan is by river. Although certain railway concessions have been granted, no roads have been built in this locality, and, due to the nature of the country, it must of necessity be years before railroad facilities are available for extensive use. In the meantime, the shipping industry will be built up with profit to whoever engages in it. Those persons may as well be Americans as any other nationality.

At the freight and passenger rates prevailing in 1916—which have not decreased, but, on the contrary, have materially increased—approximate receipts and expenditures may be determined, and thus an idea of the character of such an investment may be readily seen. For this purpose the following figures are shown:

ANNUAL RECEIPTS

16,000 cubic feet of cargo at $1.00	$16,000.00
16 first class passengers at $43.00	688.00
44 second class passengers at $21.50	946.00
170 steerage passengers at $10.00	1,700.00
Total, up trip	$19,334.00
Down trip, rates reduced one-half	9,667.00
Total, round trips	$29,001.00
Two round trips per month for 8 months, total annual receipts	$464,016.00

OPERATING EXPENSES PER MONTH

180 tons of coal at $4.50 per ton	$810.00	
150 gallons of oil at .75 per gallon	112.50	
Master	150.00	
Chief engineer	100.00	
2 pilots	90.00	
15 firemen, 3 engineers, 12 deck hands, 4 petty officers, 14 cooks and boys	720.00	
Total per month	$1,982.50	
Total for eight months		$15,856.00
Annual repairs, 20 percent of cost of vessel, assuming $150,000 as cost		30,000.00
Cost of maintenance while laid up for repairs, 50 percent of operating cost		7,928.00
Annual expenditures, exclusive of miscellaneous stores		$53,784.00

Thus if throughout sixteen round trips a steamer carries full cargo and passenger trip, the excess of receipts over expenditures would be $410,232. If it averages half load and passenger list, the excess would be $178,224.

Ichang, Hupeh province China, is a very important port on the Yangtse Kiang River in a rich agricultural country, 400 miles from Hankow and 350 miles from Chungking. Merchandise bound either way is transshipped at this point. The following data taken from the custom's report of the year 1916 show the amount of tonnage handled during that year:

Steamers entered, 370 tonnage; freight entered, 231,461
Steamers cleared, 367 tonnage; freight cleared, 232,289

The foregoing does not include freight handled by junks and sailing vessels.

Chungking, province of Szechwan, is the largest city in West China and is the shipping port of the province, also drawing from the provinces of Yunnan and Kweichow. The province of Szechwan alone has no less than

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sixty million people, and the population of Chungking is estimated at six hundred thousand. The principal exports are silk, skins, wool, wax, hides, bristles, hemp, opium, musk and wood oil. Szechwan contains undeveloped deposits of coal, iron, antimony, copper, and some silver and gold. The mineral deposits must of necessity remain unworked until transportation facilities are more fully developed.

Considerably more freight is handled by junks than steamers, due to the undeveloped state of steam navigation. Junks make the trip up from Ichang to Chungking in an average of eight weeks, and consume two weeks in the trip down.

Customs reports of 1916, showing the tonnage of freight handled during that year, is as follows:

	Tonnage
Steamers entered, 58	15,244
Sailing vessels entered, 1,096	58,150
Total	73,394
Steamers cleared, 62	16,383
Sailing vessels cleared, 809	27,643
Total	44,026

In 1917 the Standard Oil Company began operating the steamer *Meitan* between Ichang and Chungking. This steamer tows a barge alongside designed for carrying oil in bulk and in tins. In the same year the Asiatic Petroleum Company laid down a similar vessel for this service. No better evidence of the future prospects of West China can be had. The country must and will be developed; and even if this development is slow, present trade conditions demand additional steam vessels.

The practicability of navigation of the upper Yangtse for steamers less than two hundred feet in length is not widely known at present. In these reconstruction days, when people of all nationalities are reaching out for business, the possibilities of the upper Yangtse country will become known and the early investors will reap handsome profits. American shipping interests should not allow other nations to be the first on the ground.

Progress of Shipbuilding in China*

AFTER forty-four years of steam navigation in China, the shipping is still largely owned and controlled by foreign interests. In 1917 there were eighty-seven steamships engaged in Chinese coastwise trade, only twenty-seven of which were Chinese-owned; and in March of the same year 1,077 vessels of all types, aggregating 76,425 tons, were plying on inland waters, only one-fifth of which were Chinese-owned. It is natural, therefore, that in attempting to put the country on a self-sustaining basis the Chinese should regard shipbuilding and ship owning as important factors. The remarkable accomplishments which have marked the past few years in Chinese shipbuilding have more than reflected the universal interest in this industry because of war conditions and have registered a certain declaration of independence on the part of Chinese merchants.

TABLE I

NATIONALITY.	1915.		1916.		1917.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
Chinese	141,965	24,159,009	136,501	23,397,109	146,900	24,022,817
British	33,339	37,675,657	34,132	35,840,573	34,902	33,576,217
Japanese	20,141	23,873,016	21,598	24,233,835	22,454	24,581,647
Russian	4,773	1,922,055	3,790	1,545,085	3,276	1,429,200
American	3,148	804,414	3,082	799,913	3,609	1,125,155
All other	3,421	2,228,854	2,913	2,203,586	2,332	2,172,013
Total	206,887	90,663,005	202,016	88,020,101	213,473	86,907,049

* Prepared by the Latin-American Division, Bureau of Foreign and Domestic Commerce, and published in *Commerce Reports*.

CARRYING TRADE SHOWS DECREASE

The total shipping tonnage, foreign and coastwise, entering and clearing for the years 1915, 1916 and 1917 was as shown in Table I.

The following figures show the nationality, number and tonnage of ships engaged in the Chinese coasting trade for the year 1917:

NATIONALITY.	Entries.		Clearances.	
	Number.	Tonnage.	Number.	Tonnage.
Chinese	48,185	9,494,867	49,310	9,461,851
British	12,966	13,199,778	12,947	13,112,950
Japanese	8,274	8,653,325	8,338	8,729,463
American	1,425	229,819	1,418	252,977
Russian	1,240	522,866	1,206	508,533
All other	565	317,570	556	297,105
Total	72,655	32,418,225	73,775	32,362,879

The advantage these figures show for Chinese shipping is more apparent than real. Only a small number of the vessels under Chinese ownership are of more than 600 tons, and there are only twenty-seven that can be classed as steamships. Owing to inadequate railroad facilities, any serious decrease in shipping tonnage engaged in coasting trade restricts the inland commerce of the country; thus when the total foreign and coastwise tonnage entered and cleared drops from 90,663,005 tons in 1914 to 86,907,049 tons in 1917, the effect is serious.

WAR ACTIVITIES OF CHINESE SHIPYARDS

The oldest and largest shipbuilding concern in China, the Kiangnan Dock & Engineering Works, at Shanghai, is controlled by the naval board of the Peking Government. Originally designed as a navy yard for repairs to foreign-built Chinese warships, it was placed at the disposal of the United States Government in July, 1918. Arrangements were then made for the construction of four 10,000-ton ocean steamers, and an option was given for eight more of the same capacity, the steel being shipped from the United States and all other material being supplied in China. At the same time the British Government contracted with the Hongkong & Whampoo Dock Company (Ltd.) for six standard steel ships, one of 5,000 tons and five of 8,000 tons each, four of which are to be constructed with American steel. The New Engineering & Shipbuilding Works at Shanghai, which has a capacity for six ships of 5,000 tons, is also building two ocean-going vessels of 2,000 tons each; and the Shanghai Dock & Engineering Company, a British concern with five ways, has undertaken the construction of five standardized ships of 5,000 tons.

The Kiangnan Dock & Engineering Works at Shanghai employs from 1,200 to 1,500 men. When occasion requires, the plant works twenty-four hours a day in three shifts. The yard has twelve ways, is fitted with a modern equipment for construction, and has a dry dock capable of handling vessels up to 544 feet in length. In Shanghai there are about 5,000 men engaged in shipbuilding work, and in Hongkong about twice that number. The Chinese workmen are not nearly as fast as American builders, but their work is equally dependable. Their skilled mechanics are thorough and reliable. When they build a ship it is

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put together with the utmost care that mechanical ingenuity makes possible.

RAW MATERIALS AND LABOR PLENTIFUL

Whereas the steel for the first ocean-going ships to be constructed in China has necessarily been imported, it is predicted that in the near future China, possessing all the necessary raw materials in abundance, will be able to construct and equip ocean-going vessels entirely of domestic materials. There is also abundant timber for wooden-ship construction, and the many small yards capable of turning out one or two vessels up to 600 tons each will not suffer from a shortage of the necessary materials. Eighty million feet of timber are imported annually into Shanghai alone, and a like amount was in storage there in 1917.

It is estimated that there are 300 first-class Chinese ship carpenters in Shanghai capable of working from drawings, and 600 good helpers who can, with suitable supervision, produce work equal to American or European workmen. Although working slower, they are quick to adapt themselves to modern tools and machinery.

INLAND AND COASTWISE TRADE

The two leading Chinese shipping companies are the China Merchant Navigation Company and the Ningpo-Shaohsing Steam Navigation Company. The former, established in 1873, has co-operated with the Government since 1892, and has also worked hand in hand with the leading foreign shipping concerns. The following is a list of ships owned by this company:

NAME OF SHIP.	Line.	Year Built.	Tonnage.
Fung-shun	Peiyang	1875	1,300
Toonan	do	1881	2,800
Poo-chi	do	1882	1,100
Fei-ching	do	1883	1,539
Kwang-chi	do	1887	505
Hsin-yu	do	1889	1,629
Hsing-fung	do	1891	1,846
Hsing-chi	do	1892	1,846
Kung-ping	do	1894	2,475
Anping	do	1897	1,857
ai-shun	do	1897	1,962
Yu-shun	do	1900	2,962
Hsien-chang	do	1905	2,000
Hsing-kang	do	1906	2,146
Hsing-ming	do	1906	2,100
Kiang-foo	Yangtse	1873	4,000
Kiang-yu	do	1873	4,000
Kiang-yung	do	1876	3,500
Kiang-kwan	do	1876	5,500
Kiang-hsin	do	1905	3,372
Kuling	Hankow-Ichang	1885	250
Kwei-lee	do	1893	879
Kiang-tien	Ningpo	1870	3,800
Hai-tien	Wenchow	1874	1,300
Hai-an	Fuchow	1874	1,300
Irene	Amoy-Swatow	1890	1,343
Chi-yuan	Hongkong-Canton	1891	3,000
Kwang-lee	do	1883	3,000
Kwang-tah	do	1883	3,000
Mei-foo	do	1870	2,500
Kiang-tung	Canton-Macao	1870	566

The Ningshoa Steamship Company has two vessels, of 1,300 and 999 tons, respectively, which ply between Ningpo and Shanghai, and up the Yangtse River to Hankow. Two companies, the Yuen On and the Shiu On, maintain a ferry service between Hongkong and Canton; the Szechwan Steam Navigation Company operates two steamers on the upper Yangtse Rapids, and three other small steamers, owned by Chinese companies, also operate on this waterway.

In addition to the above, motor-boat service is maintained on the Kueikiang River in South China, with an extension on the West River, despite the difficulties of navigation at some seasons of low water. These boats are of about 60 tons and burn liquid fuel.

There is little doubt but that the present war incentive to Chinese shipbuilding will witness a replacement of the old and slow vessels with newer and faster types. It may even lead to the creation of a large seagoing fleet of Chinese vessels. The war has awakened China to its capabilities as a shipbuilder, and experience has shown China the advantages of being a shipowner. With the proper encouragement the shipping industry there may prove itself only the harbinger of industrial awakening and the forerunner of economic independence.

Registered Japanese Shipping

The *Japan Advertiser* states that, according to latest investigations made by the Department of Communications, the vessels registered in Japan at the end of December, 1918, consisted of 2,641 steamers, aggregating 2,310,959 tons, and 12,431 sailing vessels of 857,556 tons. Steamers over 1,000 tons numbered 616, with a gross tonnage of 1,859,349, the particulars being as follows:

Classification	Number	Gross Tonnage
1,000 to 2,000 tons	237	334,088
2,000 to 3,000 tons	144	348,354
3,000 to 4,000 tons	96	320,907
4,000 to 5,000 tons	39	175,948
5,000 to 6,000 tons	49	279,513
6,000 to 7,000 tons	23	146,199
7,000 to 8,000 tons	13	98,206
8,000 to 9,000 tons	1	8,150
9,000 to 10,000 tons	8	76,028
Over 10,000 tons	6	71,896
Total	616	1,859,349

During the war boom in 1917, the shipbuilding slips in Japan totaled 145, but about 40 of the smaller shipyards, established to take advantage of the boom, have since been closed, so the present number of slips is 105. This loss occurred chiefly in slips for small vessels, which were built by shipyards of comparatively limited means, and it is said that in future efforts will be concentrated on the construction of large vessels, though at present the Japanese shipbuilding industry is very depressed.

Composite Ships Being Fitted with Diagonal Strapping

An innovation in composite ship construction was introduced recently by R. A. Polhamus, naval architect of the Mobile Shipbuilding Company, Mobile, Ala., with the view of adding strength to the hull and eliminating vibration. This innovation, consisting of diagonal strapping in the hull, was first utilized in the *Dalgada*, the third of a fleet of six 3,500-ton composite vessels for the Emergency Fleet Corporation.

On the trial trip of this vessel there was a noticeable absence of vibration, and so well pleased were the executives of the company with the results that it was decided to install the strapping in the three remaining ships, the *Balosara*, *Obak* and *Oyaka*. The pleasing surprise came when the *Morganza*, the second ship of the fleet built by the Mobile company, was ordered to Mobile from New Orleans to be fitted with the strapping. The *Morganza*, since acceptance, has been operating for the United Fruit Company out of New Orleans to Cuba. The *Buckhannon*, of similar type, built at Slidell, La., which is also at the Mobile yard for additional work, is likewise being fitted with the diagonal strapping at the order of the Emergency Fleet Corporation.

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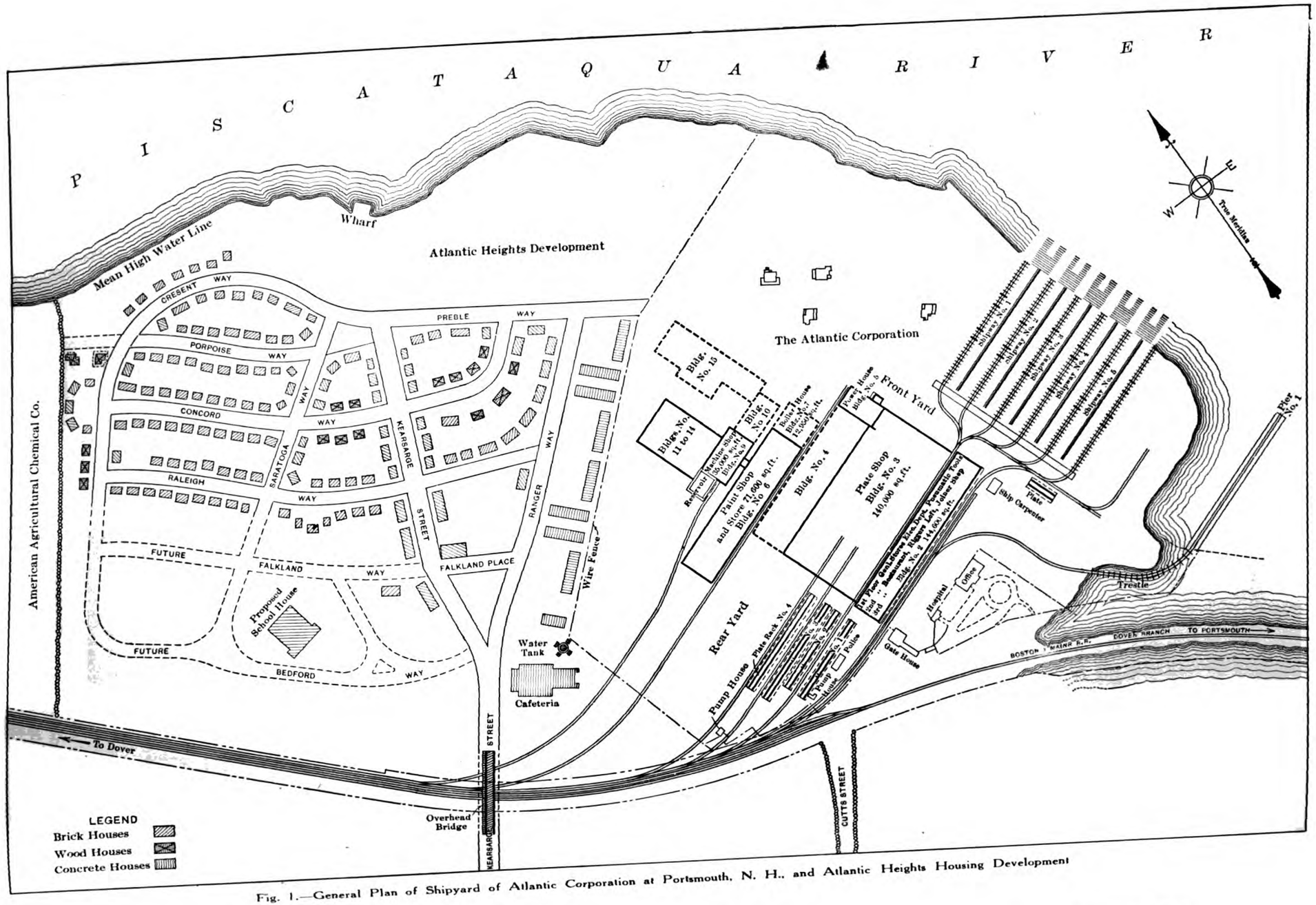

Fig. 1.—General Plan of Shipyard of Atlantic Corporation at Portsmouth, N. H., and Atlantic Heights Housing Development

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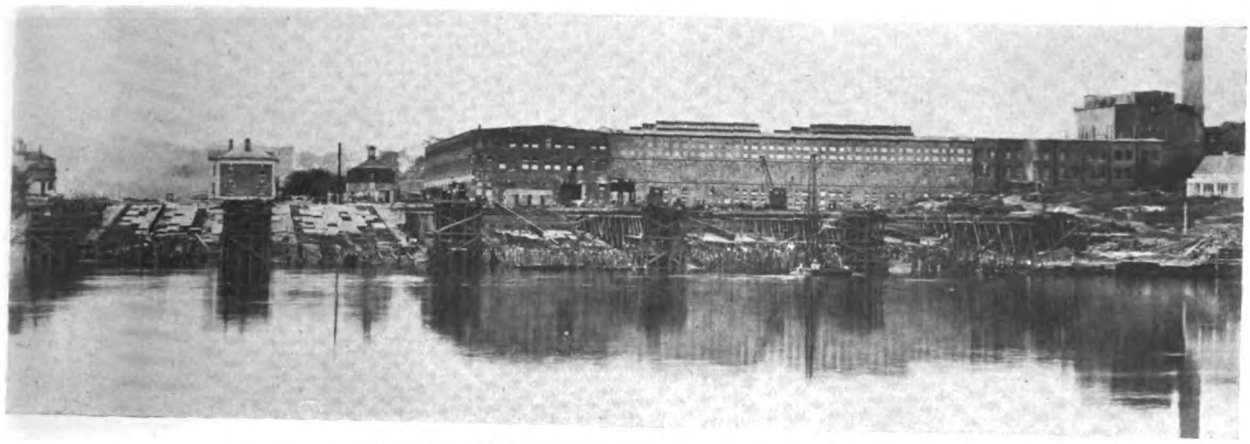

Fig. 2.—Waterfront of Atlantic Corporation Yard

Shipyard of the Atlantic Corporation

Five-Way Plant for Building Steel Ships Established at Portsmouth, N. H.—Facilities for Training and Housing Workmen

BY C. E. DOWNTON

THE Atlantic Corporation, Portsmouth, N. H., was organized in December, 1917, for the purpose of building steel cargo ships for the United States Shipping Board Emergency Fleet Corporation. Ten vessels of the *Robert Dollar* type were allotted under a contract that called for the complete fabrication, construction and equipment of the ships ready to receive crew and cargo.

The yard, which was secured through purchase of the plant of the Colonial Paper Company, consists of 125 acres of land located at Freeman's Point, one mile northwest of the city of Portsmouth on the banks of the Piscataqua River, a district made famous through the shipbuilding achievements of our first admiral, John Paul Jones, who personally supervised the construction of many naval vessels used in our country's early struggles for independence. Among them were the *American* and *Ranger*, which rank with the best of our early battleships. Furthermore, the latter was the first ship to hoist the "Stars and Stripes" to its masthead.

Famous Ships Built at Portsmouth

Later history records the building of the *Kearsarge*, Admiral Farragut's flagship, and many noted clipper ships of the kind comprising our early merchant marine in the days when America proudly ranked among the foremost nations of the earth in commerce bearers.

Fig. 3.—Shipways, With Material Storage and Assembling Space in Foreground

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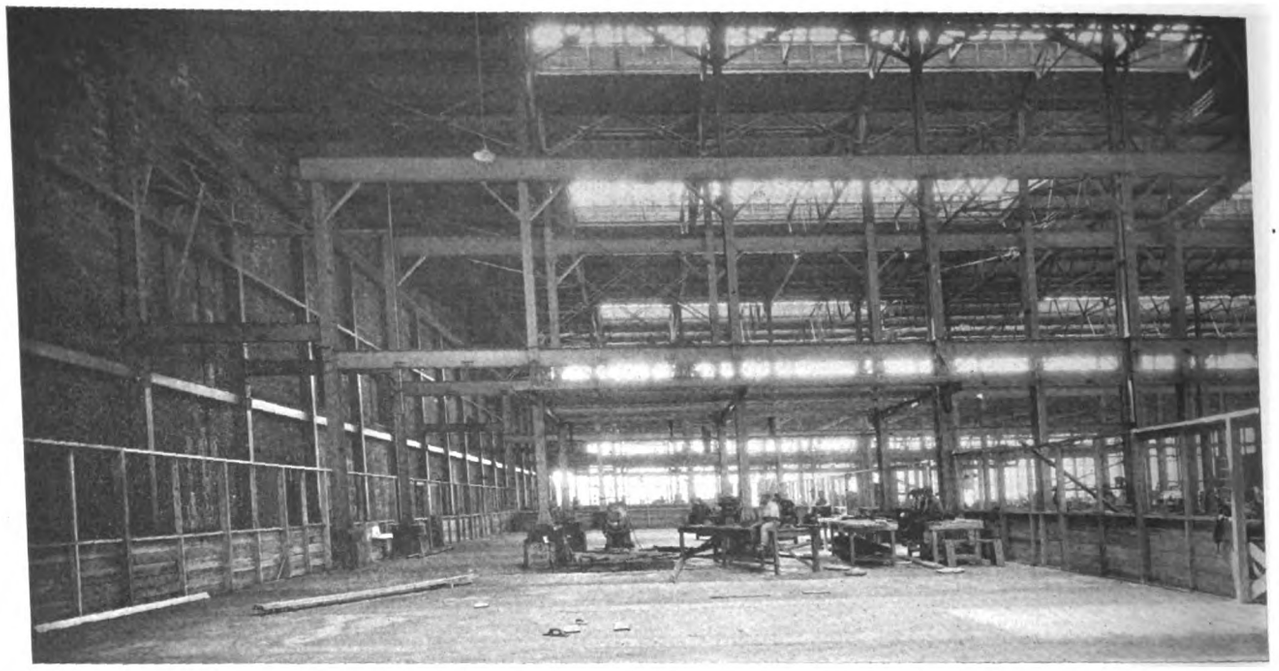

Fig. 4.—Interior of Shop Building, Showing Type of Construction

In earlier days, Portsmouth was a rival of Salem and other New England coast cities in their quest for trade, and many landmarks remain of days when the toilers of the seas made up the greater portion of our substantial population along the Atlantic coast. Under these circumstances it was but natural for Portsmouth again to come to the fore when shipbuilding assumed such important proportions in the attempt of the "great generals of industry" to meet the war emergency.

SHOPS AND OFFICE BUILDINGS

The permanent structures used for manufacturing purposes at the yard are of substantial mill construction well located and easily adapted to the requirements of shipbuilding. The buildings under roof contain approximately 483,000 square feet of floor space, 413,000 square feet of which is now being utilized, and plans have been formulated requiring additions to the machine shop and foundries. The location of the main office building interfered with the placement of shipways Nos. 4 and 5, necessitating its removal intact to a position two hundred yards west and directly in front of the manufacturing buildings.

The yard has five shipways, each capable of accommodating a vessel 450 feet in length, but which can be ex-

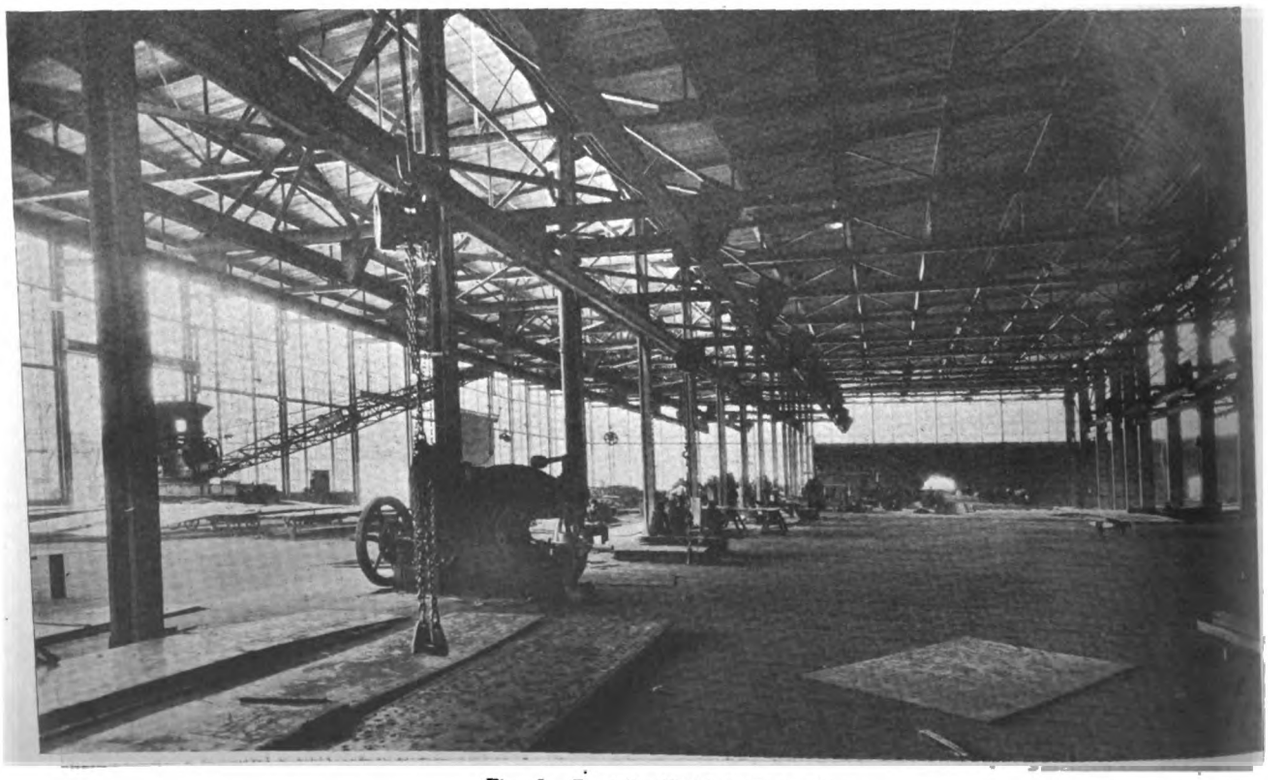

Fig. 5.—Partially Finished Plate Shop

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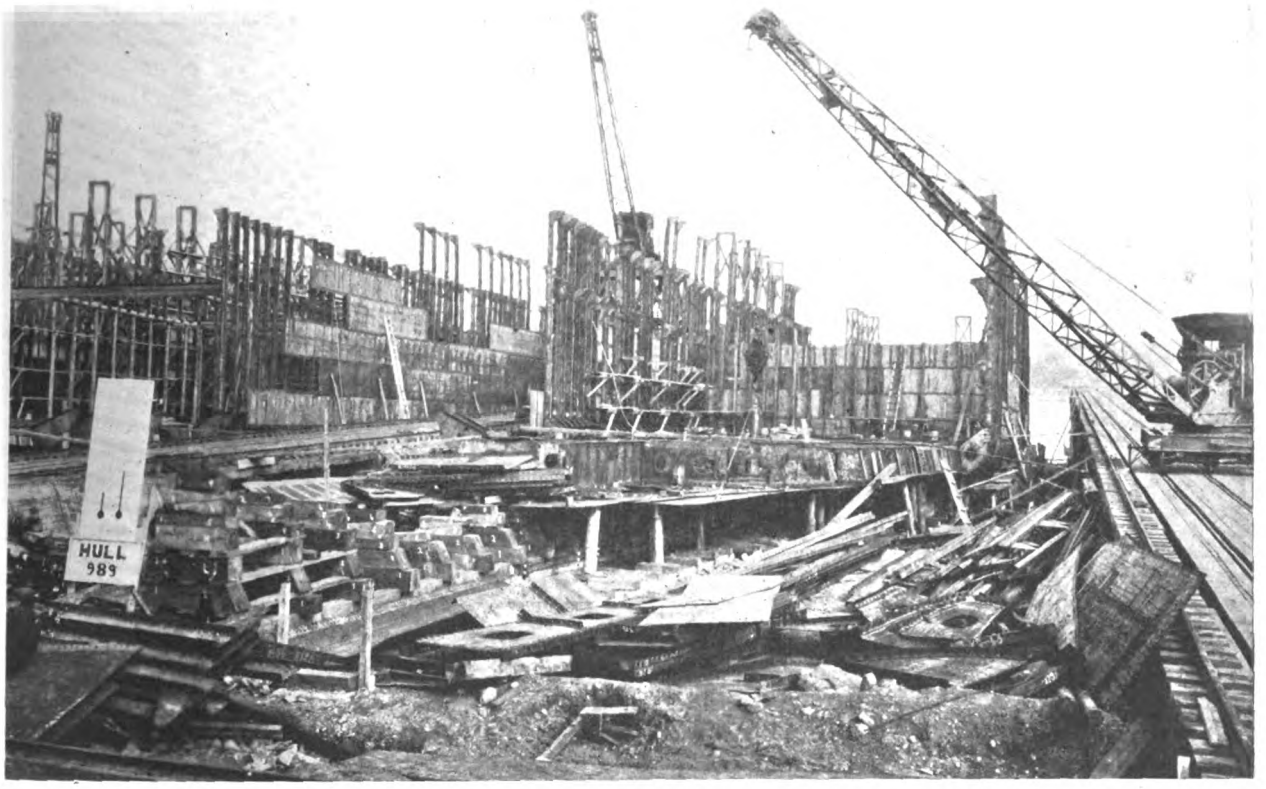

Fig. 6.—Vessels Under Construction on Shipways

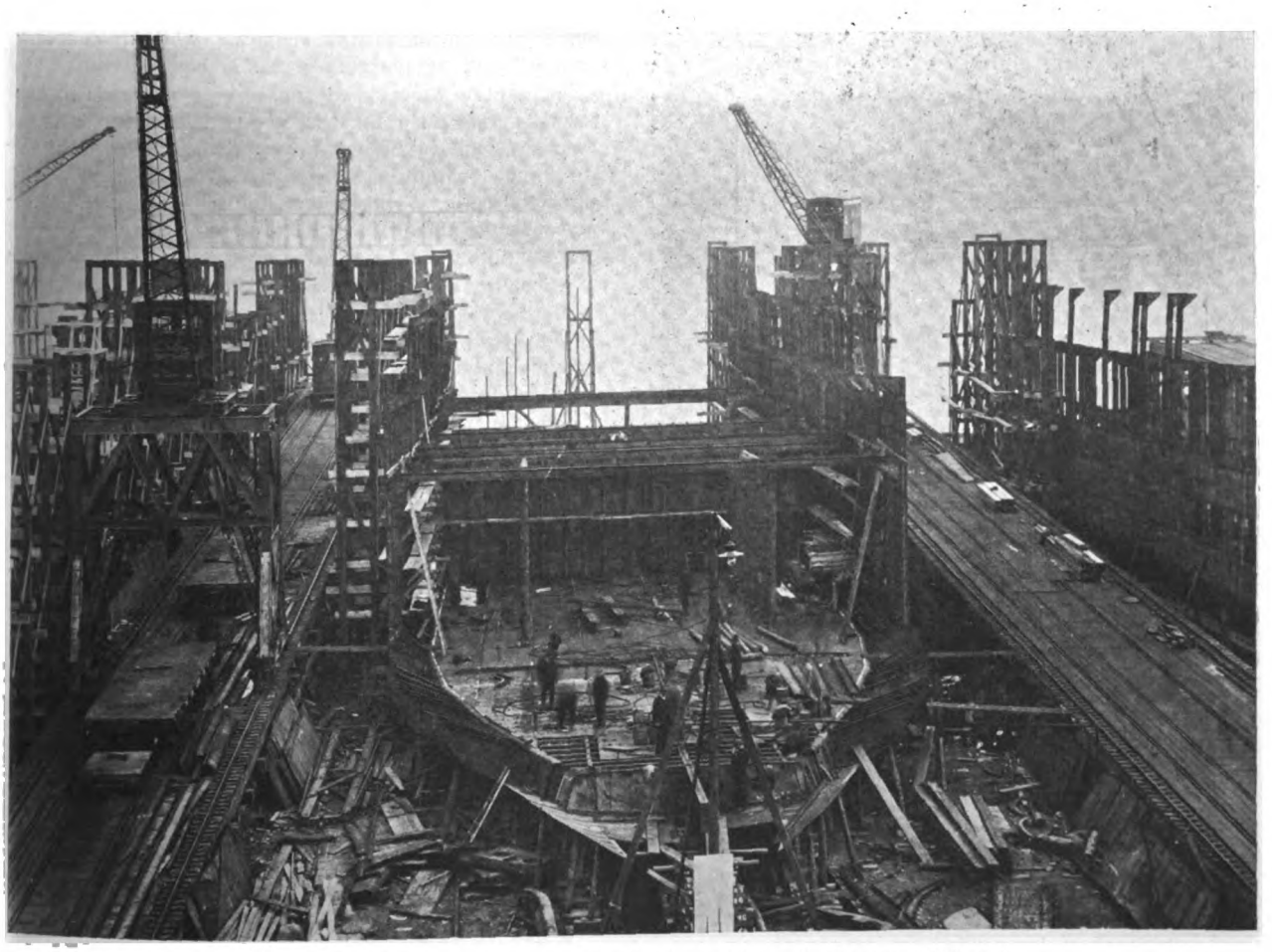

Fig. 7.—View of Shipway, Showing Portable Tower Cranes for Handling Material

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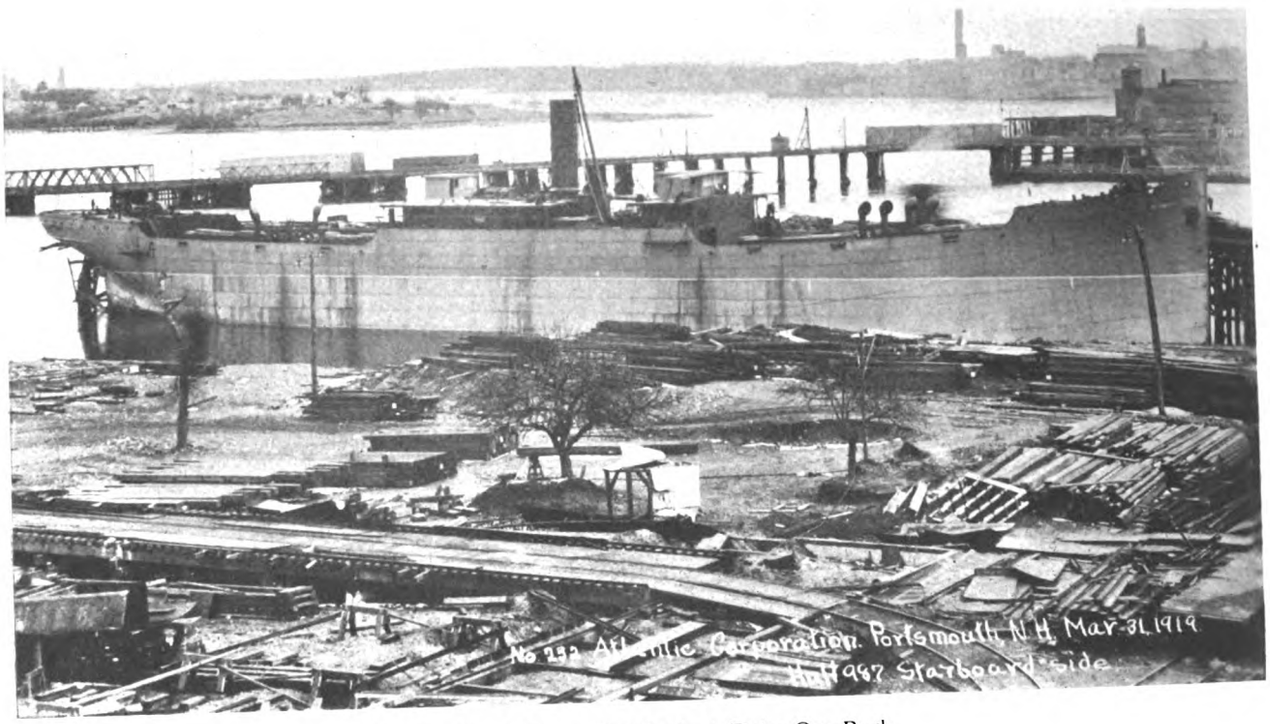

Fig. 8.—Vessel Being Completed at Fitting-Out Berth

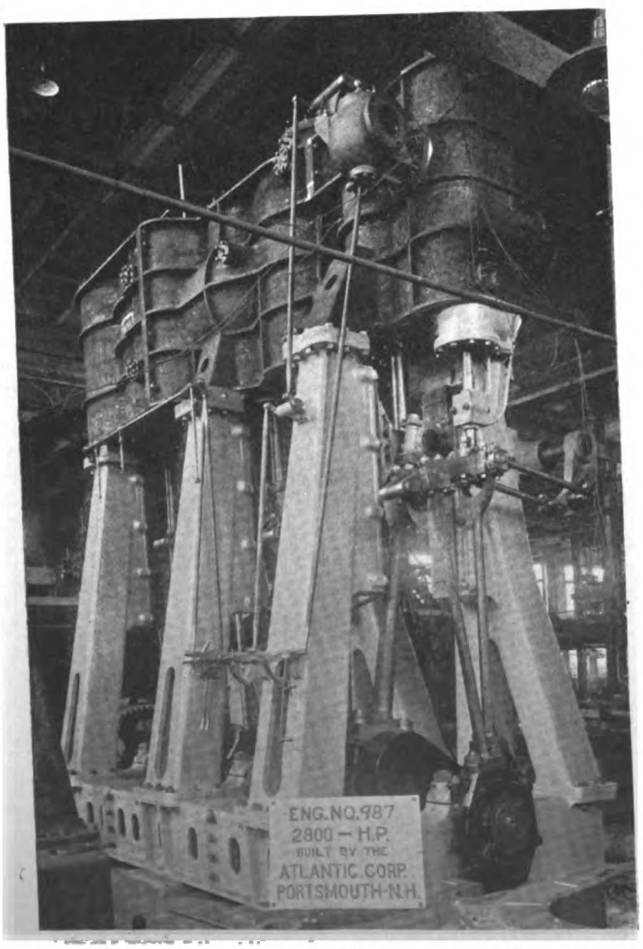

Fig. 9.—Type of Engine Built by Atlantic Corporation

tended to take a 600-foot ship. The shipways consist of central keel blocks resting on piling, while the launching ways are laid on concrete blocks and piling.

The gantry ways, used for serving materials of construction, rest on piling and are each equipped with two electric boom revolving tower cranes. Brownhoist & Browning locomotive cranes are used in handling the materials in the yard. A transfer table at the end of the ways permits the shifting of the gantry cranes from one way to another. The excavation for the ways was begun in February, 1918, and the first keel was laid on May 23, 1918.

The river in front of the ways has an average width of 500 yards and a depth at mean low tide of from sixty to seventy-five feet. The banks drop off abruptly at the end of the launching ways to a depth of over thirty-five feet. The river empties into the Atlantic Ocean two miles east of the plant and the depth of water throughout this distance ranges from forty-seven to one hundred feet.

PLATE SHOP

The ship shed, which covers an area of 141,000 square feet, contains the plate and angle furnaces, bending slabs, hydraulic presses, hammers, forges, shears, planers, bending rolls, punches, joggling presses, etc. There is also ample space for the assembly of frames, brackets, smokestacks, spars, masts, small bulkheads, shaft stool, etc.

The plate racks for storing incoming materials are located at the west side of the ship shed. Four rows of racks are arranged to receive plates on edge. The cars are run in on spurs from the Boston & Maine Railroad, each spur serving two rows of racks. The plates are brought into the ship shed on cars to the laying-out tables, from which point they move in the proper sequence of operations, progressing toward the east side. Two over-

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head Northern Engineering electric traveling cranes of ten tons capacity, a small locomotive crane, numerous jib cranes fastened to the building columns, several electric trucks and platform trucks are used in handling the material within the ship shed, three sides of which, in addition to a portion of the roof, are of glass, thus giving full use of natural illumination.

A standard gage track enters the southwest corner of the ship shed and passes through the building to the southeast corner for the delivery of materials to the hulls, spur tracks radiating to each ship gantry way and outfitting dock.

Larger bulkheads, shaft tunnels and fantails are assembled in the yard near the shipways. Fabricated material in small allotments can be stored at the head of the ways.

The machine shop is particularly well equipped with cranes and machine tools suited to the manufacture of medium-sized marine engines. Triple-expansion engines of 2,800 horsepower are to be used in the present vessels.

Power Plant

All machine tools and other equipment are either electrically or pneumatically operated, the power being generated in a central power plant of 1,060 kilowatts capacity made up of the following machines:

One 500-kilowatt, 600-volt, 3-phase alternating current Curtis generating set.

One 400-kilowatt, 220-volt direct current General Electric generator, Corliss engine-driven.

One 100-kilowatt, 220-volt, direct current Sturtevant vertical engine-driven.

One 60-kilowatt, 600-volt, 3-phase alternating current generator direct connected to Sturtevant high-speed horizontal engine.

The turbine is supplied with the necessary condensing apparatus.

The boiler house is equipped with four 500-horsepower Babcock & Wilcox boilers fired with Rielly stokers; also modern fuel- and ash-handling apparatus.

The ground floor of building No. 2 contains the general stores, electrical department, pneumatic tool room; second floor, the joiner shop, riggers' loft, division of mold loft, and a restaurant with a seating capacity for four hundred, and the third floor contains the ship stores, engine and hull drafting rooms, blue printing and main mold loft with a free area of 29,000 square feet.

Training of Workmen

Special attention has been given to educational development; training of unskilled men for riveters, chippers and calkers, holders-on, heaters, etc., following the plan used by the Westinghouse companies through the use of skilled mechanics as instructors. Many of these men have had the advantages afforded by the training center established through the efforts of the training department of the Emergency Fleet Corporation.

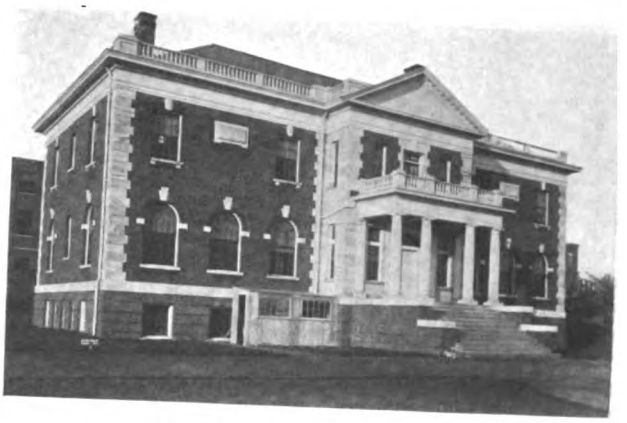

Fig. 10.—Main Office Building

Skilled and unskilled men are sent through the training department by the employment department, assignments of skilled men being made to the various departments after they have been tried out by the training department. The unskilled men are kept under instruction for a sufficient time to enable them to do the work of the particular craft for which they have been engaged, re-classification being made according to the schedule laid down by the Shipbuilding Labor Adjustment Board.

This training is carried through in connection with the construction of one hull, which is devoted almost exclusively to this work. New employees, old employees transferred to new crafts, and unskilled men who have been under training are followed up through weekly investigations by the employment department for a period sufficient to learn their capabilities for the work. Those unable to qualify after a reasonable time are either reclassified, changed to more suitable work or discharged.

Classes in blue print reading and ship terms are available three evenings per week from 6:45 till 9 o'clock in the Portsmouth High School building.

It is the purpose of the management to institute a more comprehensive course of training covering apprenticeships in the various crafts; also special courses for the development of foremen, leading men and skilled mechanics in the science of their trades, making a detailed study of the trade, the job and the man, and the executive qualities required to properly direct the work.

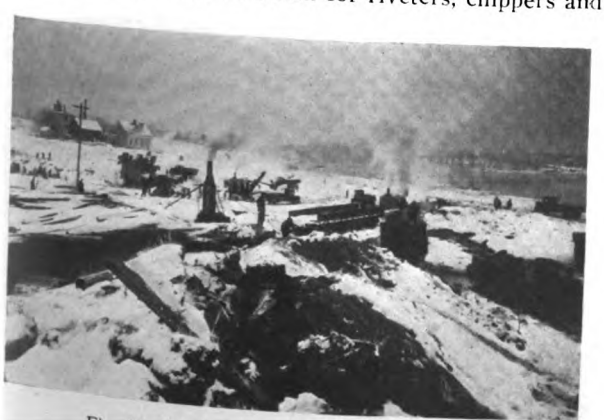

Fig. 11.—Beginning of Yard Construction

Fig. 12.—Way No. 1 Six Days After Laying of First Keel

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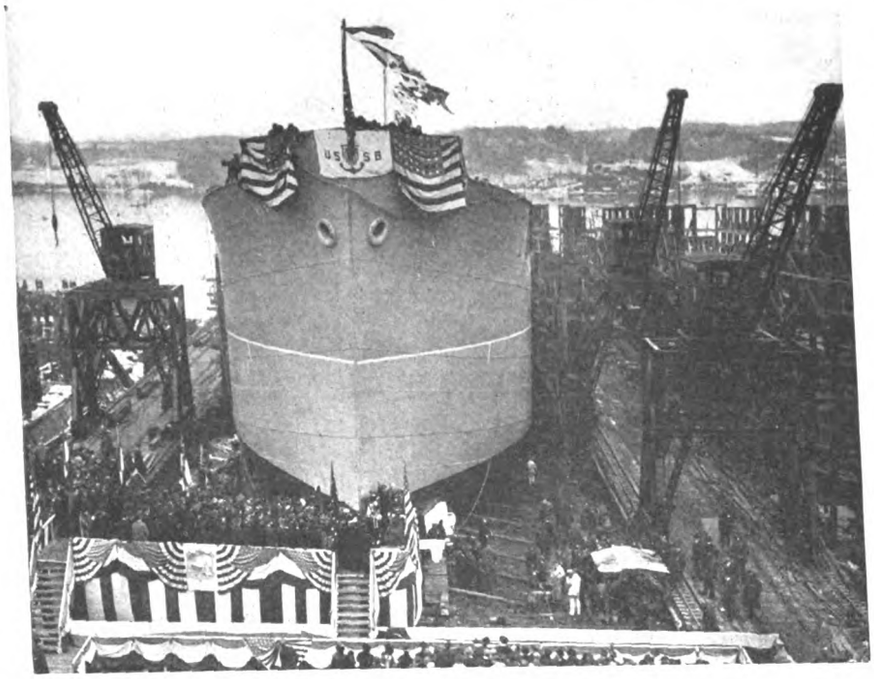

Fig. 13.—S. S. *Kisnop*, Launched January 18, 1919

Attention has been given to promote the best interests of the workers, and any venture that tends to improve their contentment is encouraged. There is a branch bank for the convenience of the workmen, the Employees' Reference Committee and a suggestion system.

Housing Facilities

The housing facilities of Portsmouth soon proved inadequate, a condition that assumed very serious aspects until the Emergency Fleet Corporation undertook the development of a housing plan in an adjacent property of approximately 60 acres, known as Atlantic Heights, where eight dormitories were erected, each containing forty-eight single rooms furnished complete. The buildings are steam heated and electrically lighted, screened windows, three showers and a tub bath on each floor, lavatories and a large living and writing room, and, in addition to the above, two hundred and seventy-six houses were erected, varying in size from four to six rooms, containing every modern improvement. These houses are of the best building construction.

The vessels being built are of the *Robert Dollar* type of 8,800 tons capacity, 427 feet in length, 54 feet beam and 24 feet depth. The first ship, the *Kisnop*, was launched 70 percent complete on January 18, 1919, eight months from the laying of the keel. This vessel was outfitted at the mooring dock at the south section of the yard and was ready for her trial trip on May 1.

The second vessel was launched May 3, 1919, 85 percent complete, and others are expected to follow in rapid succession. This compares favorably with the results obtained at similar yards where construction work was carried on contemporaneously with shipbuilding and the men had to be trained in the knowledge of the crafts applying to the art of modern ship construction.

Fig. 14.—View of Dormitories, Atlantic Heights

Fig. 15.—Bird's-Eye View of Atlantic Heights

Norway's Shipping Losses During the War

The Royal Norwegian Navigation Bureau has officially announced that Norway's loss at the end of 1918 comprised 629 steamships, aggregating 1,031,360 gross registered tons; 178 sailing vessels, aggregating 194,777 gross tons; 17 motor boats, aggregating 10,591 gross registered tons, and 5 barges, aggregating 3,327 gross registered tons, making a total of 829 vessels, aggregating 1,240,055 gross registered tons. The loss of human lives was 1,155.

At the outbreak of the war in 1914, Norway's registered merchant fleet comprised 3,405 vessels, aggregating 2,626,708 gross registered tons. The loss, therefore, calculated on a percentage basis, is 24.11 percent of the vessels and 47.08 percent of the tonnage. Norway's war loss is therefore without comparison the greatest of the Scandinavian countries. On January 1, 1919, 155 steamships and motor boats, aggregating approximately 94,000 tons, were under construction in Norway.

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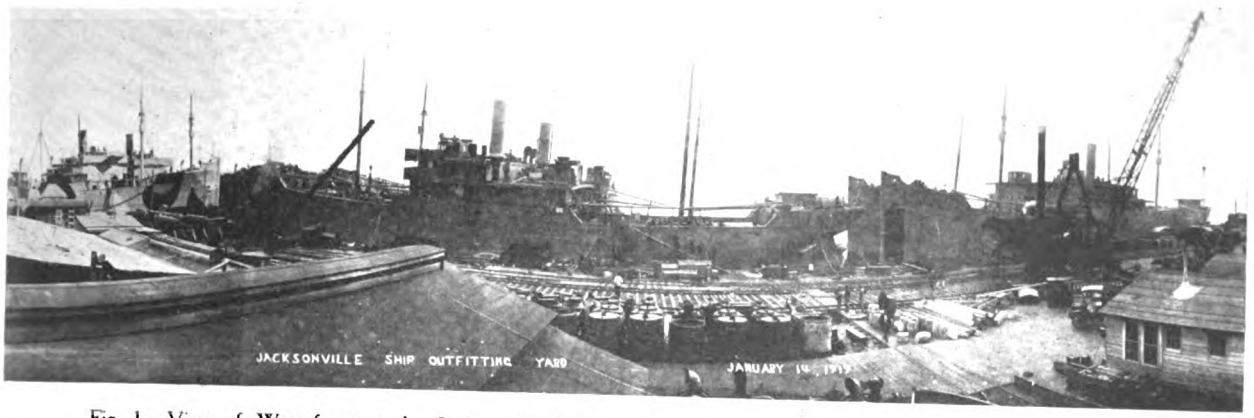

Fig. 1.—View of Waterfront at the Jacksonville Outfitting Yard, Showing Six Completed Vessels at the Dock

Quick and Efficient Machinery Installation by Jacksonville Plant

Records Made by Jacksonville Outfitting Yard in Fitting Out Emergency Fleet Vessels—War Plant to Be Continued as Repair Yard

BY E. T. HOLLINGSWORTH, JR.

REALIZING the absolute necessity of quick installation of machinery in the ships being constructed by yards of the South Atlantic for the Shipping Board in order to get the vessels ready for service, John Clarence Temple, of Newport News, Va., general manager of the Jacksonville Ship Outfitting Yard, Jacksonville, Fla., secured a contract to install the machinery in twenty 3,500-ton Ferris type hulls in February, 1918, and on April 15 (less than one month from the time work was commenced on the big plant in Jacksonville) a crew of skilled mechanics, the necessary buildings, appliances and accessories were in readiness for the arrival of the first hull.

As has been demonstrated during the war emergency, ship construction by unskilled labor is enough to try the patience of more patient men than those at the head of the big new industry. In those plants, however, wherein hulls have been built by unskilled labor in fairly good time, when it came to installing the machinery in the vessels, in many instances, the 3,500-ton ships, which required eight months to build, also required a like time to get ready for their sea trials.

In securing this contract, therefore, Mr. Temple, who had had considerable experience in similar work for the government, realized that, unless he could bring to his yard men who were experts in their respective trades, the deliveries of ships for service would be no farther advanced than if the builders themselves were doing the work. On August 29, however, when the first vessel sailed from the plant for her sea trial, the advisability of securing skilled workmen in machinery installation work was demonstrated

Record Is Made

From July 2 to November 12 the Jacksonville Ship Outfitting Yard installed the machinery in seven 3,500-ton Ferris type ships, and on this date, when the Shipping Board was calling for quick deliveries, the plant decided to go out after a record. On November 12, at noon, the steamship *Tyee*, built by the Morey & Thomas shipyard in Jacksonville, was towed to the docks of the Jacksonville Ship Outfitting Yard, and on November 26, exactly twelve and one-half working days from the time the vessel arrived at the plant, she stood her dock trial. This record has not been duplicated in the ship machinery installation annals of the United States, although several very close records have been announced, and clearly shows that, in addition to being skilled in their respective trades, the men must maintain at all times the utmost loyalty to their employer.

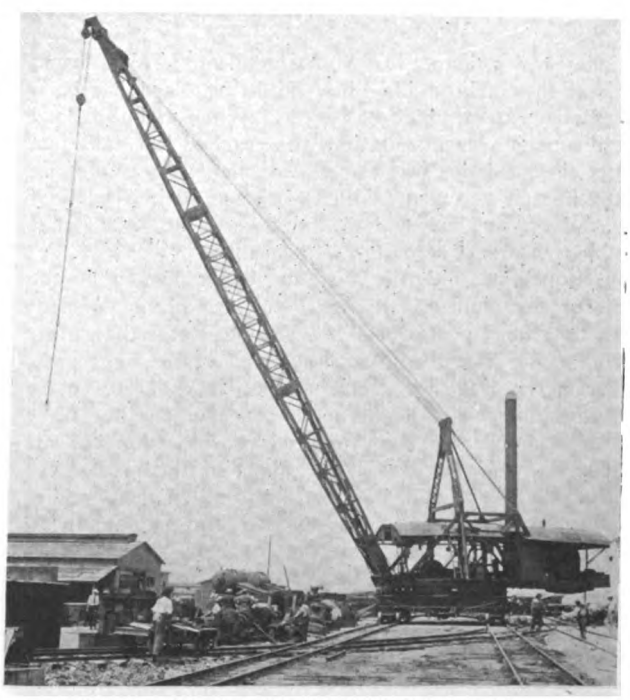

Fig. 2.—Fifty-Ton Derrick With 125-Foot Boom

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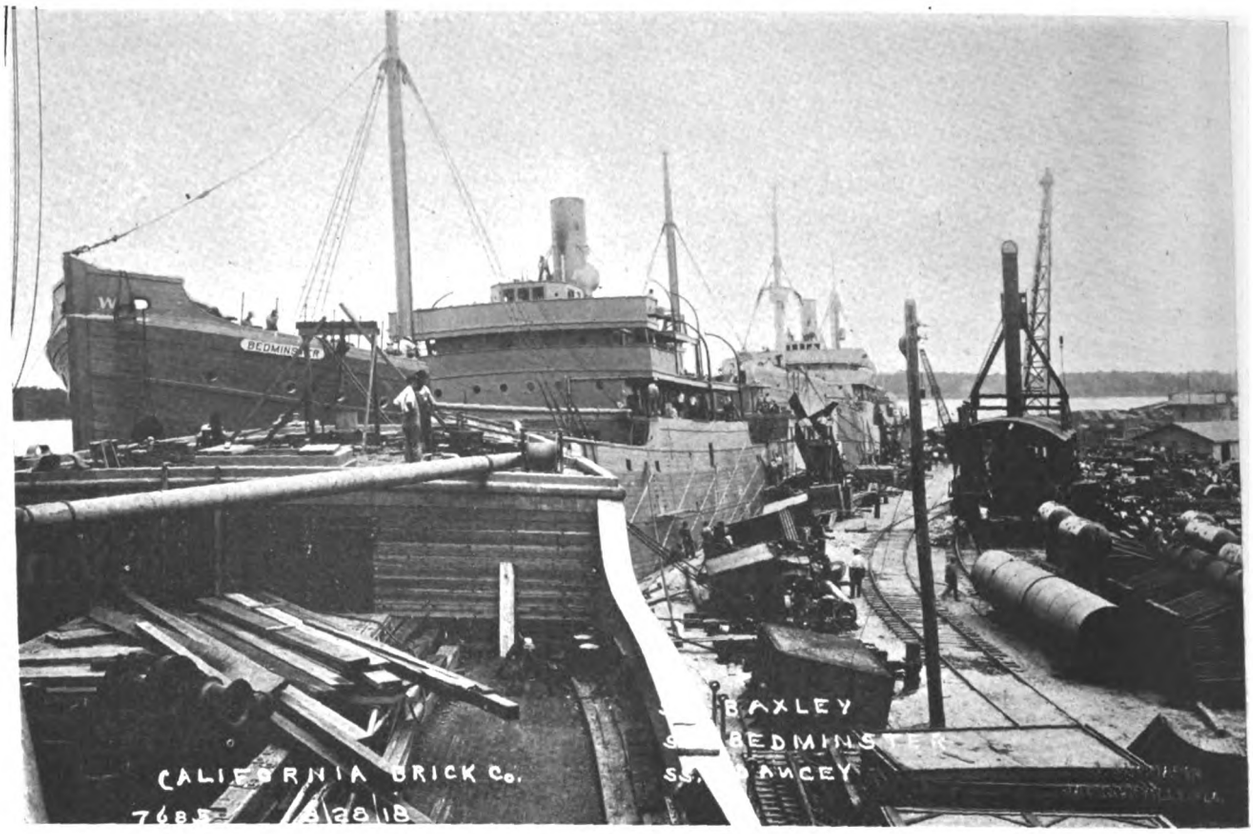

Fig. 3.—First Two Ships Completed at the Jacksonville Outfitting Yard

From July 2, 1918, to the present date, the Jacksonville Ship Outfitting Yard has completely outfitted fifteen Ferris-type hulls, and holds contracts for several additional vessels of this type, as well as contracts to install the machinery in two 7,500-ton concrete tankers being built by the A. Bentley & Sons shipyard in Jacksonville and two 3,500-ton concrete vessels being constructed by the Liberty Shipbuilding Company, Wilmington, N. C.

Work Is Systematized

Under the guidance of Superintendent J. V. Borum, work at the Jacksonville Ship Outfitting Yard has been systematized to the highest degree. When the peak load of ship machinery installation was reached last fall, just before the armistice was signed, this plant was employing approximately 700 men (skilled workmen at their particular trades), and never had there been the least labor trouble to mar the serenity of the plant.

In connection with the extreme loyalty shown by the men for the plant at all times, and the highly efficient work they have performed, Mr. Temple states that, after having made a study of working men in the aggregate, he has arrived at the conclusion that, in order to obtain the maximum results at minimum expense, it is necessary for the employer to show marked consideration for his employees' welfare. When the plans of the plant were first drawn they included a small hospital, adequate eating facilities and complete and up-to-date sanitary appliances. "The men realized our interest in their welfare," declared Mr. Temple, "and they felt that we looked upon them as a part of our organization, and not as mere inanimate pieces of machinery which could be replaced promptly if so desired."

According to men who have visited the plant from big shipbuilding yards of the East, the facilities for machinery installation in ships at the Jacksonville Ship Outfitting Yard are unsurpassed in the United States. The plant includes a blacksmith shop, machine shop and pipe shop capable of taking care of any repair work which might come to them. The waterfront is served by a locomotive crane with a capacity of fifteen tons and a traveling derrick with a capacity of fifty tons, the latter having a boom 125 feet long, making it possible to lift heavy machinery from ship to workshop, or from workshop across one ship and into the hold of anther moored alongside.

Another record made by the yard, which is worthy of mention, is the fact that during the nine months' history of the plant there has never been a serious accident. This last should be accredited to the efficiency of the safety organization and the alertness of the foremen.

The officials connected with the Jacksonville Ship Outfitting Yard include J. C. Temple, general manager; J. V. Borum, superintendent; O. E. Eriksen, general foreman, and N. H. Franks, purchasing agent.

The foremen of the various departments are: C. H. Blackburn, assistant general foreman; T. Eriksen, foreman outside machinist; J. R. Barker, foreman inside machinist; William Linder, foreman boiler maker; F. M. Rainey, foreman pipe fitter; R. H. Beazlie, foreman electrician, and J. Carraras, foreman ship carpenter.

To Continue Work

Although started primarily as a war industry to take care of the ships being constructed by the Shipping Board, the success of the Jacksonville Ship Outfitting Yard has been so marked that the concern has decided to continue the operation of its plant in the future and repair such vessels that might come to Jacksonville or the South Atlantic after the last hull contracted for by the Shipping Board is steaming her way to foreign ports.

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The Follow-Up Department at Squantum

Special Department Organized at Squantum Plant of Bethlehem Shipbuilding Corporation, Ltd., to Eliminate Delays in Executing Rush Contracts

BY G. HOBART STEBBINS

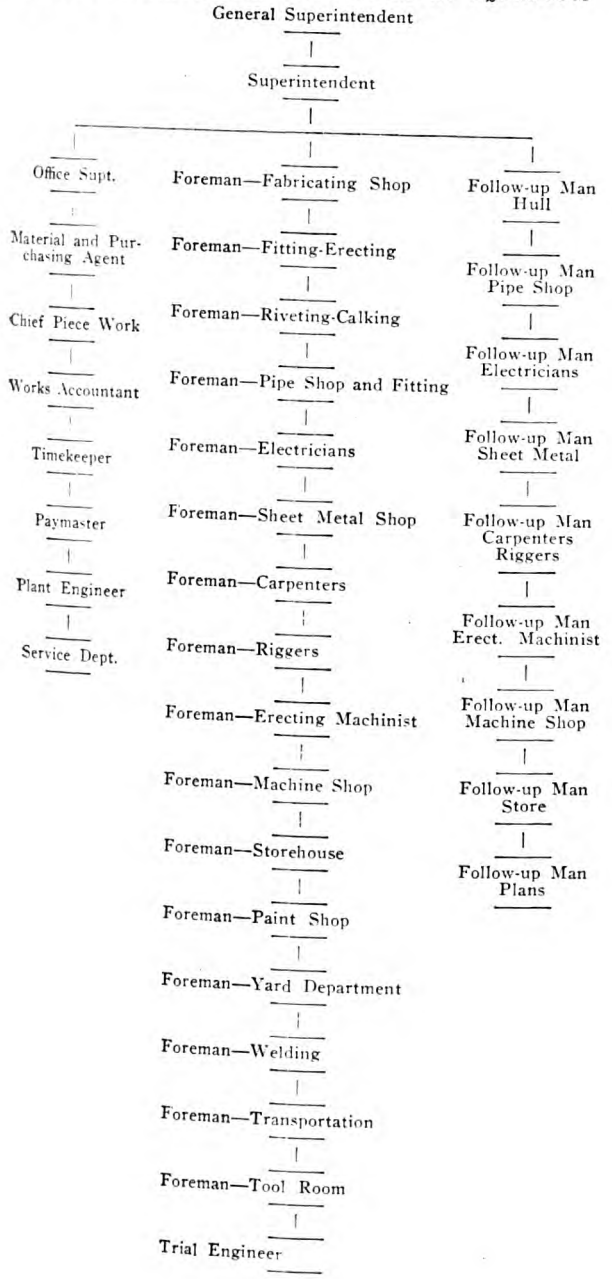
IN the fall of 1917, after the new Squantum works of the Bethlehem Shipbuilding Corporation, Ltd., had been authorized, the officials of the old Fore River plant were confronted with the proposition of building up a new organization of seven thousand men. The Squantum yard was to specialize upon destroyers, and the Navy Department was placing every possible emphasis upon the necessity for building these vessels quickly and in quantity In the organization of the new yard, the old Fore River plant gave every possible aid, but with its own rapid expansion it had difficulties enough of its own. Materials for the construction of the destroyers were coming from all parts of the country, and at a time when freight congestion was at its worst. These conditions, together with the impossibility of getting experienced shipbuilders, made the proposition a difficult one.

The first step in building up a new organization was the appointment, by the manager of the Fore River plant, of the new superintendent. The company was very fortunate indeed in having for this position a man of exceptional caliber and one thoroughly schooled in shipbuilding. Upon the new general superintendent fell the burden of organizing Squantum, although the officials of the parent plant gave every possible co-operation. The next move in organizing the Squantum works was the selection by the general superintendent of his superintendent. The two men worked out further details of organization together. The plan of organization was first thought out thoroughly, and then each department head was selected from the material available. The foremen were picked one by one, as also were the heads of the office departments.

In addition to this there was built up a special department called the "follow-up department." This consisted of seven independent departments, each corresponding to one or more of the yard departments, and each responsible directly to the superintendent. In contrast to the foremen, who were practically all experienced men, well seasoned in their respective trades, the follow-up men were young men, picked rather for their training and initiative than for their familiarity with destroyers. Some of them had already had good shipbuilding experience, while others were entirely new to this work. They were all hired weeks before their actual work was under way, in order that they might have time to get acquainted with their work.

The plan of organization established at the Squantum works is shown below:

PLAN OF ORGANIZATION ESTABLISHED AT SQUANTUM



The duties of the newly organized follow-up department were as follows:

1. To schedule all work for the corresponding production department.
2. To record work done and submit to the superintendent a progress report each week.
3. To keep corresponding production department informed on their work holding up the department.
4. To keep other follow-up men informed on their work holding up the department.
5. To be responsible for the delivery of all necessary materials and products bought from outside the plant.
6. To provide all materials and products found necessary, but which were not covered by outside order.
7. To take up with the drawing room all matters of changes and delays in drawings and bills of material.
8. To take up with the government inspectors matters relating to inspection of material and proposed changes in construction.
9. To perform other work of technical, engineering or clerical nature that circumstances might bring up.

The first use made of the follow-up department was to get out schedules of all work to be done in each department. These schedules were based on a master schedule giving laying of keel, launching and delivery of each ves-

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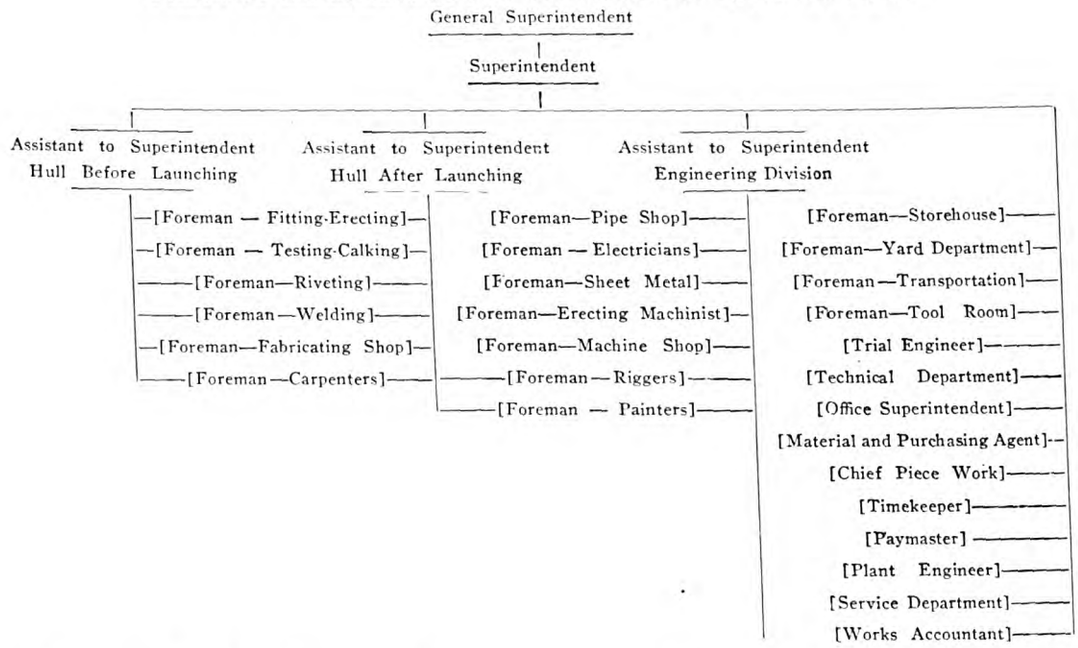
sel. The master schedule itself gave the earliest dates that the leaders of the corporation thought possible. In making up schedules, the follow-up men were in constant consultation with one another because every department was so closely connected with each of the others.

For an example of the method of procedure, take the scheduling of the spring bearings. The outside machinists need these in place soon after a boat is launched in order to proceed with the installation of the line shafts and reduction gears. This, then, gives the structural department the date upon which the spring bearing foundations must be completed. The plate and angle shop must get out the plates and shapes early enough to give the structural department time for erection and riveting. The machine shop must deliver the spring bearings to the outside machinists at launching. This means that the shop must machine the brasses and send them to the pipe shop to terials and products for the emergency contract, many items were necessarily overlooked. When such instances were brought to the attention of the follow-up men, it was part of their work to get them ordered both for immediate needs and in quantity for the entire contract. It also frequently happened that, although items were on order, delivery could not be obtained in time for the first vessels. Here the follow-up man had to find a way out of the difficulty, either by using some allowable substitute, by borrowing from the old plant at Quincy, or by locating it in the local market.

The follow-up men found another important function in getting drawings and bills of material corrected. The contract covers the first destroyers of the type to be built, and many alterations and additions had to be undertaken on the first vessels. The follow-up men, in many cases, collected the necessary data for these changes themselves. When this was impractical, they kept in close touch with the drawing room until the desired corrections were made.

FOLLOW-UP DEPARTMENT AS NOW ESTABLISHED AT SQUANTUM PLANT



have the cooling coils brazed in. The brasses then come back to the machine shop to be finished-machined and assembled. The assembly calls for a brass cover, which must be made up by the sheet metal shop. Each of these departments therefore must arrange its schedule accordingly in order that the installation of machinery can proceed without delay.

The progress report turned in to the superintendent was based on a comparison between the percentage of time gone according to schedule and the percentage of work done. From this one could readily see what jobs were lagging and investigate to determine the cause of delay. In every case where one department was held up by unfinished work of a second department, it was the duty of the respective follow-up men to get together with the foremen and eliminate the hold-up.

Not only was the schedule designed to help the foreman in laying out his work, but it also was intended to tell the follow-up man when materials on outside order were needed. By following the schedule, the follow-up man was able to bring pressure upon those items which were most urgent. Actual dealings with outside concerns were conducted through the material department, but this did not relieve the follow-up department from responsibility.

Due to the unavoidable speed required in ordering ma-

As mentioned above, many times it was found necessary to make substitution both in materials and methods of construction. All such matters had to be taken up with local government inspector, and the follow-up department was the logical means of doing this. In fact, whenever practical, all matters relating to government inspection were conducted through the follow-up department.

In addition to the seven original follow-up men, two others were later added whose duties were of a slightly different nature. The plan follow-up man was made responsible for the issuing of all drawings and bills of material and the taking up of matters relating to them with the drawing room for the follow-up men. The plan follow-up man was also the Squantum representative to the old Quincy plant. All inter-plant business was conducted through him. This was a very important function, since the drawing rooms, order department, purchasing department, brass foundry, blacksmith shop and other important departments are located at the old yard.

There remains the store follow-up man, whose duty it was properly to order all warehouse stock needed on the job. All special items required in the construction of the

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vessels, such as castings, valves and auxiliary machinery, were ordered by the order department at the old plant. In addition, there was a large order put through for general warehouse stock, to be used as occasion required. When material was found necessary which was apparently not covered by the warehouse stock, the store follow-up man, in conjunction with the other follow-up man, investigated the item in question. It was his duty to see that material was not duplicated, that the proper quantities were ordered, and that the proper specifications were given.

The value of the follow-up department manifested itself in innumerable ways. The hull follow-up man, for instance, developed with his foremen an entire system of operation for the structural departments. This comprised the marking and storing of raw material, the system for following each piece through the fabricating shop, and the method of assembly and erection.

The pipe follow-up man developed a manufacturing sheet detailing each pipe and tabulating its material, length, bore, gage, flange specifications and the pieces immediately adjoining each end. This was of great value at the beginning of the job in breaking in green men. The follow-up man for the electrical department made up his own bills of material, collecting data here and there wherever they were obtainable.

It was found that the machine shop could not begin to turn out the required amount of machine work. The follow-up man made an analysis of conditions and the machine work was finally distributed at his discretion among three additional shops. The store follow-up man has saved the corporation much money by his careful analysis of the stock situation.

As the work progressed at the Squantum works and the vessels began to be launched, the superintendent found that his duties were assuming too large proportions for him to handle alone. Also the night force was beginning to number several hundred men. The important function of the follow-up men had been to aid in getting the first impetus into the organization, and, as it became organized to operate in a routine manner, the work of the follow-up men diminished; consequently, they were withdrawn one by one to build up the supervising force.

The two follow-up men on hull work were made assistants to the superintendent, in charge of hull construction. One is responsible for the construction up to and including launching, while the other takes the vessels when they enter the water and follows the construction through delivery. The follow-up man for the pipe shop was made assistant to the superintendent, in charge of engineering. The plan follow-up man was made night superintendent in charge of hull construction, and the follow-up man for the erecting machinists was put on engineering night work. The follow-up men for the sheet metal department and the machine shop were transferred to further bolster up the engineering division.

The positions vacated by these promotions were filled by the assistant follow-up men who had been receiving good training in that capacity. They continued to carry on the work of the respective departments as before. But, as the material situation began to straighten out more and more, the work became gradually less. Most of the difficulties of the follow-up department were overcome in delivering the first vessel, after which the work became largely a matter of duplication.

At this point, when the work of the follow-up department did not warrant the maintenance of seven independent departments, they were combined in one. This department, known as the "technical department," carries on the same work but is a more compact organization.

Steel Boilers and the Board of Trade

The Board of Trade's rules for the construction of steel boilers are being considered with the view to certain amendments being made; but, as the details are not yet ready for publication, and as the construction of a large number of boilers under the Board's survey is probable in the near future, a brief statement of the approximate changes which will result has been issued for the information of the surveyors, engineering firms, boiler makers and users interested therein.

It should be understood that the amendments apply only to boilers made of steel manufactured by firms in the Board's list in Section 108 of the Instructions as to the Survey of Passenger Steamships, the boilers being open for inspection during construction, the workmanship of the highest class as required for the lowest factor of safety, and the Board's existing rules complied with in all respects except as amended below. The following data are embodied in the statement referred to:

CYLINDRICAL SHELLS

$$\frac{s \times (t - 2) \times J}{2.8 \times D} = \text{working pressure,}$$

where s = minimum tensile strength of plates in cylindrical shell, in tons per square inch.
t = thickness of shell plates in thirty-seconds of an inch.
J = smallest calculated percentage strength of longitudinal joint, as determined by ascertaining (1) the plate percentage strength, (2) the rivet percentage strength, and (3) the combined plate and rivet percentage strength.
D = inside diameter, in inches, of the shell plates in the strake considered.

The maximum pitch of the rivets may be increased to 12¼ inches. In other respects the riveting should be in accordance with the Board's existing rules.

BUTT STRAPS

To be in accordance with the existing rules, excepting that, in every case, ⅛ inch is to be added to the thickness of the inside strap.

FLAT PLATES

The pressures allowed by the Board's rules, using the constants and formula in the printed instructions, may be modified as follows:

Constant 240.—On end plates up to and including ¾ inch in thickness, the pressure obtained by the present rules should stand. On end plates 1¼ inches thick, the pressure allowed may be increased by 10 percent. For plates of intermediate thickness a proportionate increase of pressure may be allowed.

Constant 210.—As with constant 240.

Constant 165.—As with constant 240, but substituting ⅞ inch and 1⅜ inch respectively for the thickness mentioned as allowable for constant 240.

Constant 150.—As with constant 240, but substituting ⅞ inch and 1⅜ inches respectively for the thickness mentioned as allowable for constant 240.

Constant 100.—Pressures allowed on combustion chamber plates supported by nutted stays are to be calculated by the present rules.

Constant 66.—Pressures allowed on combustion chamber plates supported by riveted stays to be calculated by the present rules for plates up to and including ½ inch in thickness. For plates 11/16 inch thick, the pressures allowed may be increased by 6 percent.

For plates of intermediate thickness, a proportionate increase of pressure may be allowed.

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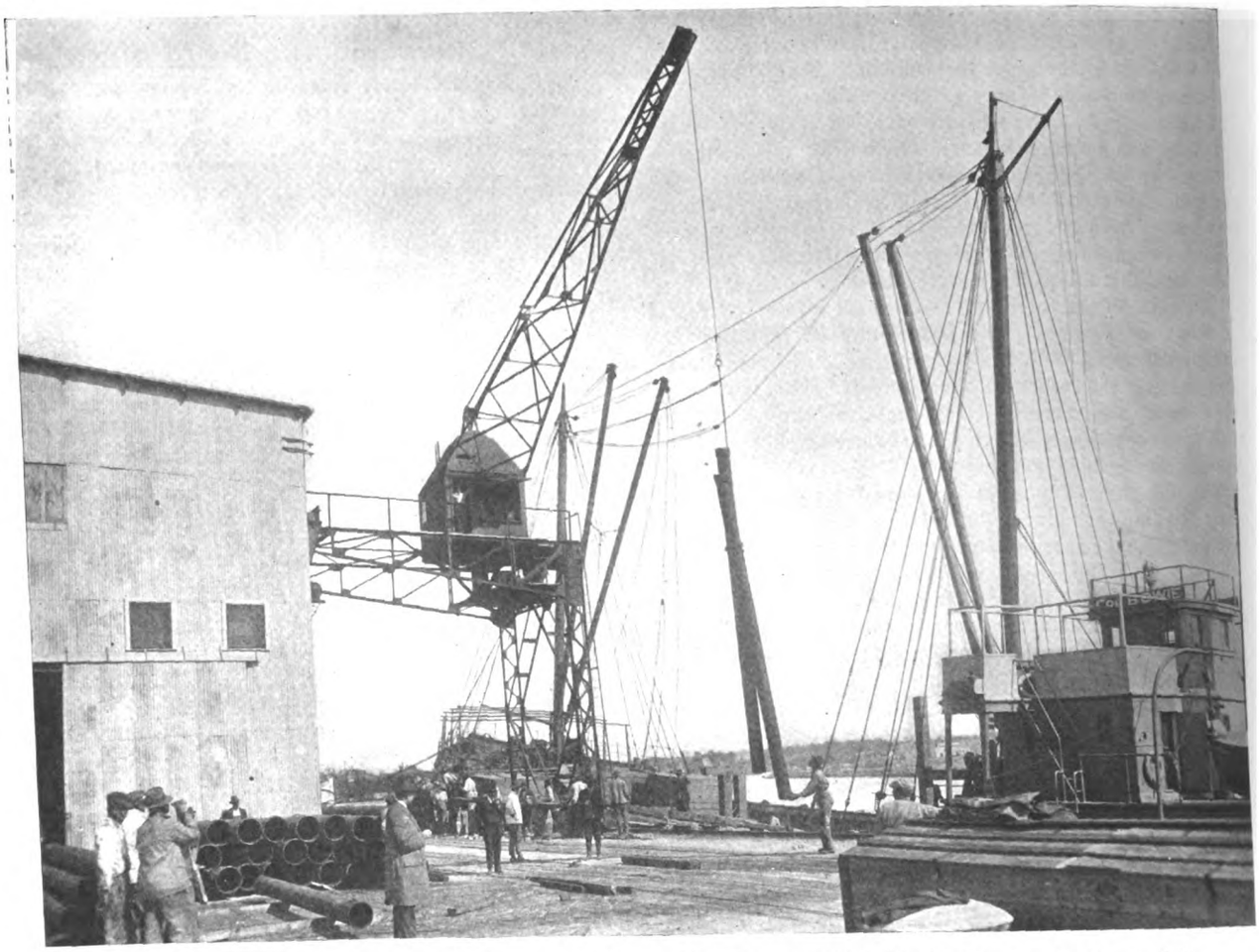

Transferring Long Water Pipes Between Vessels and Shore at the Beaumont, Tex., Marine Terminal by Means of the Traveling Gantry Jib Crane

TUBE PLATES

In accordance with the Board's existing rules for the present.

COMBUSTION CHAMBER STAYS

In accordance with the present rules.

STEEL LONGITUDINAL STAYS

Stays having threads screwed not coarser than six per inch:

$$\frac{(D - 0.34)^2 \times 9{,}500}{\text{area supported}} \times \frac{s}{28} = \text{working pressure,}$$

where D = diameter of the stay over the threads in inches.
s = minimum tensile strength limit of stay, which should not exceed 28 tons per square inch.

The maximum stress per square inch allowed is not, however, to exceed 10,600 pounds for steel stays of 27 tons, and 11,000 pounds for steel stays of 28 tons tensile strength per square inch.

In cases where the ends are enlarged and the body of the stay is smaller in diameter than at the bottom of the threads the rule will be:

$$\frac{(d - 0.125)^2 \times 9{,}500}{\text{area supported}} \times \frac{s}{28} = \text{working pressure,}$$

where d = smallest diameter of the stay, in inches.
s = minimum tensile strength limit of stay, which should not exceed 28 tons per square inch.

The above is conditional on the longitudinal stays of double-ended boilers being efficiently supported at the mid-length position.

STAY TUBES

For iron stay tubes as at present used, without the material having been tested in the Surveyor's presence, a stress of 7,000 pounds per square inch on the net section may be allowed.

FURNACES

The working pressure which may be allowed on corrugated furnaces should be ascertained by the following formula:

$$\frac{c \times (t - 1)}{D} = \text{working pressure,}$$

where D = external diameter at the bottom of the corrugation or camber, in inches.
t = thickness at the bottom of the corrugation or camber, in thirty-seconds of an inch.
c = 480 for furnaces of the Fox, Morison or Deighton section, and 510 for furnaces of the bulb section made by the Leeds Forge Company.

HYDRAULIC TEST

For boilers whose working pressure (W. P.) does not exceed 100 pounds per square inch:

W. P. $\times$ 2 = hydraulic test pressure in pounds per square inch.

For boilers whose working pressure exceeds 100 pounds, but does not exceed 200 pounds per square inch:

W. P. $\times$ 1½ + 50 = hydraulic test pressure in pounds per square inch.

For boilers whose working pressure exceeds 200 pounds per square inch:

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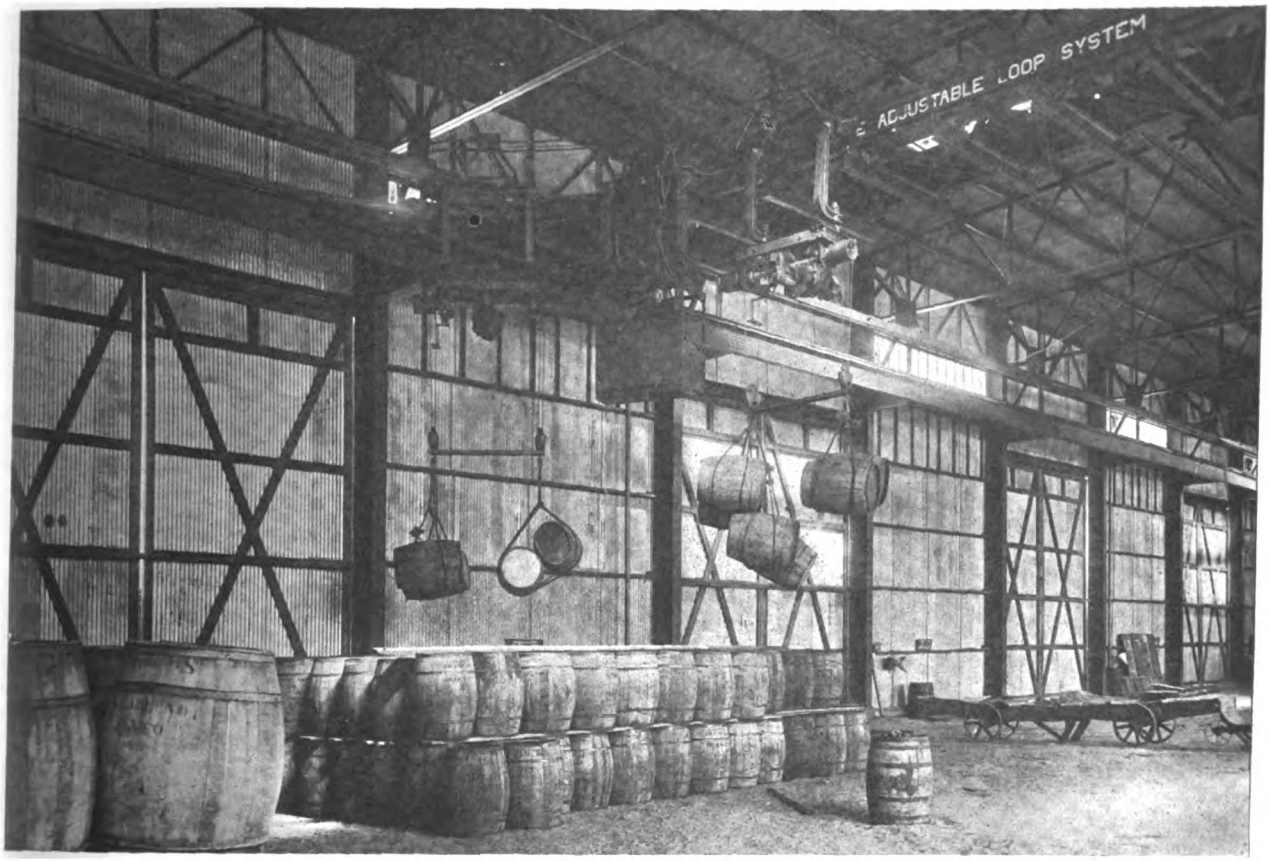

Handling Barrels of Asphalt Along the Terminal Shed at Beaumont, Texas, Including Counting, Distributing and Tiering

W.P. × 1¾ = hydraulic test pressure in pounds per square inch.

The foregoing brief statement is issued at the present time in order that makers and users of boilers may take immediate advantage of the amendments contemplated in the rules now under consideration.

Boiler designs should be submitted as early as possible, in order that any necessary amendments may be made before the material is ordered.

Operating Crane Costs in the United States

BY H. MC L. HARDING*

WHILE there are many figures giving the costs of operation of traveling gantry jib cranes in Europe and South America, yet it is important to have these costs for cranes now being operated in the United States under the present prices for electricity and labor.

It is also necessary to know what is the charge to the shipper or consignee by the municipality, which should not only be the operating costs of the cranes with the expenses of maintenance, interest and amortization, but also include any profits for the use of the cranes added and for ready comparison should be reduced to a common tonnage basis.

The following letter of March 6, 1919, gives most completely this information. The city of Beaumont, Tex., charged the shipper four and four-tenth (4.4) cents per ton for cranage, as expressed in the letter:

"On this date we handled the following amount of freight, from ship to pier: 2,103 barrels of asphalt, lift 40 feet, swing 50 feet, in eight hours and thirty minutes, at a cost to shippers of $25.16 for use of gantry cranes, or 1,051,500 pounds of freight at a cost of $.002 per pound, or 4⅛ barrels asphalt per minute at a cost of $.012 per barrel.

"(Signed) O. S. HUNTER,
"Harbor Master."

Beaumont, Texas.

* Consulting marine terminal engineer, New York.

American Cargo Handling Equipment Used at French Ports

SOON after the declaration of war by the United States Government, American engineers formulated plans for handling the coal and food products which would be necessary to sustain an army of over 2,000,000 men, many thousands of miles from its base. American cargo-handling machinery followed in the train of American engineers. It is safe to say that practically every French port is equipped with a number of American-made cranes.

At the two American ports from which supplies were forwarded to the United States forces, Brownhoist locomotive cranes of the gantry type are installed. Other makes of cranes of the same type are also in use here. At St. Nazaire, four standard 8-wheel Brownhoist locomotive cranes and as many standard 4-wheel locomotive cranes are in use on the dock for handling miscellaneous cargo. The type of 4-wheel crane used in this installation is shown in Fig. 2. The cranes in this picture, however, are shown in use on the River Seine, between Rouen and Paris. Four raised pier cranes are installed on one of the quays at Brest for unloading miscellaneous cargoes and grain, and six of the same type have been installed on another quay. These cranes were also used at this port for handling army supplies. Cargoes were unloaded

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Fig. 1.—Government Coal Storage Yard at Bonneinl-sur-Marne, Where Twenty Brownhoist Cranes Are Installed

faster than they could be taken away from the wharves at these ports by four railroad trucks and accessory motor trucks.

As cargo freight and coal were handled, however, in many parts of France, American cargo-handling machinery was installed from the extreme north to the far south. Starting at the north, we find the port of Dunkirque equipped with two Brownhoist 4-wheel cranes. At Havre, which is equipped with two of the Brownhoist raised pier cranes, as shown in Fig. 3, ten pontoon cranes and one 4-wheel crane are also in use. These pontoon cranes are being operated by the American Expeditionary Forces alongside the vessels for handling miscellaneous cargo. At Rouen, two large capacity pontoon cranes and seven 4-wheel cranes handle the coal which is being reloaded from barges to cars and stock piles. About twenty more Brownhoist standard locomotive cranes are located at the various small river ports between Rouen and Paris. In the outskirts of the French metropolis, six Brownhoist standard cranes are in use unloading miscellaneous material from the river barges.

At the Government coal storage yard at Bonneuil-sur-Marne, twenty-one of the Brownhoist standard locomotive cranes handle all the coal which is received in river barges and delivered to cars or placed in storage. Fifteen of the raised pier cranes are used in unloading the coal and grain at Cherbourg; five standard cranes are also used for the same purpose and for placing coal in storage at this port. At Roquefort, six of the raised pier cranes are used for cargo handling.

Moving along the coast to La Rochelle, two raised pier cranes are found unloading cargo, as well as two standard cranes which are used for handling miscellaneous freight. In the south, Brownhoist raised pier cranes and some of the standard cranes are used on the River Gironde, around Bordeaux, at Bassens, at Cette, at St. Louis-du-Rhone, and at Marseilles.

Those who have seen the extensive cargo-handling machinery equipment in use abroad are insistent in their demands for the installation of similar efficient facilities throughout this country. It is pointed out that unless the wharves and docks serving ocean vessels and the warehouses along the inland waterways of America are equipped with modern machinery, we will be unable to compete with France and England in future trade development.

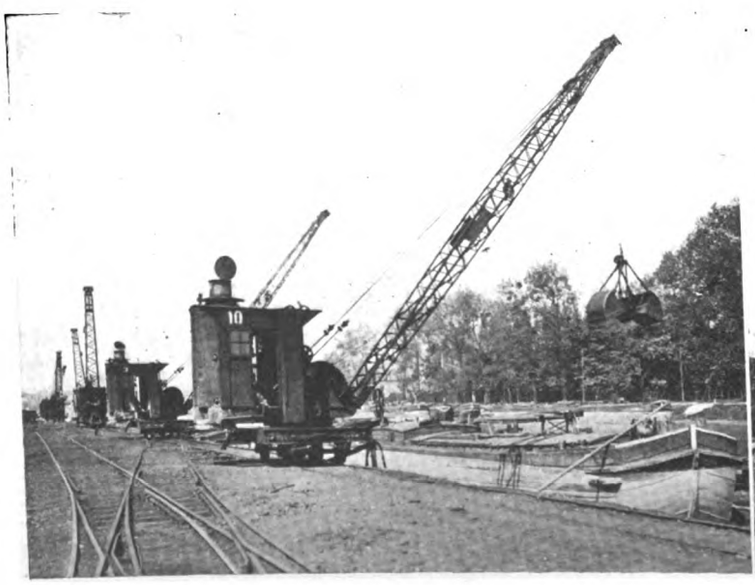

Fig. 2.—Cranes Used Along the River Seine Between Rouen and Paris

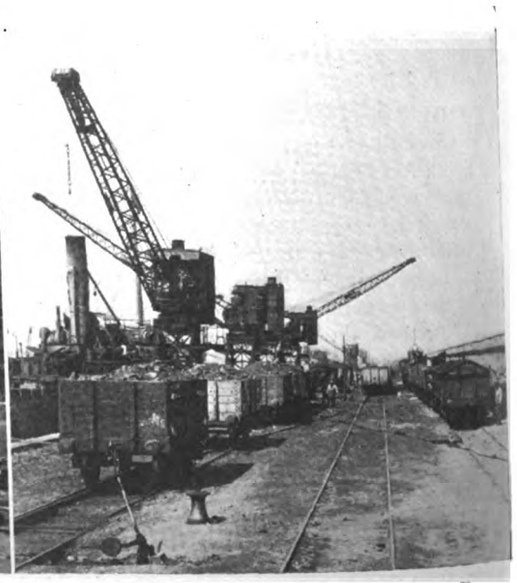

Fig. 3.—Raised Pier Cranes in Use at Havre

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Four Million Cases of Saya Bean Oil Handled by Machinery at Seattle Marine Terminal

The Coming Mechanical Devices that Will Make Ship-Loading Economical*

Modernizing Port and Harbor Terminals—Crane Hoists—Overhead Telpher Systems—Electric Tractors and Trailers—Improved American Ports

THE entire question of building a great foreign trade for America contains no more important element than the problem of modernizing the port and harbor terminals by which our railroad systems and our ocean-going vessels are connected. In our war-time haste we concentrated on ships without giving enough attention to the equally important problem of providing adequate facilities by which cargo may be economically handled and without which we would not be in a position to compete with maritime nations that have been studying harbor and ship economies for decades.

Now that we have successfully met the tremendous emergency brought by the war, we are beginning to ascertain just what our status as a world trading and carrying nation really is. Whatever controversy may exist in connection with the future ownership of our merchant marine or the policy by which it is to be managed, all are agreed that our port and harbor facilities must be taken hold of in an energetic manner and brought up to the same standard of efficiency that characterizes most of America's typical industrial processes.

The spirit of optimism that pervades every recent discussion of port and harbor development is the best guarantee of what is to come. Before the United States had a merchant marine of its own it was a difficult matter to arouse public interest in port problems. Now that the vital connection between a successful future for our merchant ships, our export trade and our loading and unloading facilities has been recognized, the best engineering and mechanical brains in the country have set to work to devise appliances by which the United States, with wage scales nearly double those of its overseas competitors, may still win out through the medium of increased efficiency per man and per machine.

The concrete results of the efforts made up to this time to improve our ports are already beginning to assert themselves. On the Pacific, Gulf and Atlantic coast, cities with foreign trade aspirations are studying what may best be done to cut transportation costs and to assure for ships a quick and economical turn-around. Machinery is beginning to make its appearance on docks and piers where the repeated efforts of manufacturers in past years have met with no response. Everything now points to a development in the handling of general cargo, on which export trade depends to a high degree, that will put the ports of America as far ahead of its European competitors as they were formerly behind.

The difference which has always existed in the United States between the handling of general cargo and the handling of specialized cargo like coal, ore, oil and grain is very marked. No nation in the world has ever approached the record made by American ships in handling bulk cargoes. Our Great Lakes cargo carriers have made low-cost tonnage records that have been openly scouted and ridiculed abroad. These records were made possible by the wonderful loading and unloading devices which emptied ships in hours where the same number of days was once required for the job. Costs per ton have been reduced until ore can now be taken from Duluth or Superior to Conneaut, Ohio, or other ports adjacent to the Pittsburgh district for a lower charge than any other tonnage rates in the world.

The work which has now been undertaken by the port engineers and machinery makers of America is to duplicate this showing with boats built for carrying the miscellaneous cargo of which the bulk of export trade is made up. To devise a machine for loading coal is one thing; to devise apparatus that can handle pianos one minute and steel rails the next is a much more complex affair.

* From *The Americas*.

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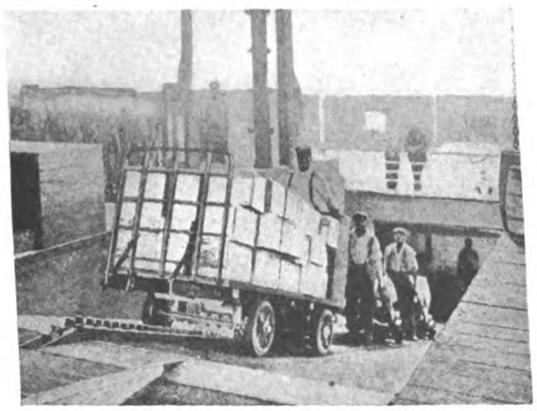
The methods formerly used for the direct operation of getting general cargo into merchant vessels in this country were a long way behind those of the most modern European ports. The amount of time lost, wages paid, dock charges incurred and other costs which were run up under the old system of loading ships by hand was bad enough in peace time, but under the necessities of war they



Combined Electric Truck and Lift

became little less than criminal. It was clear that one of the most vital problems to be solved was that connected with the direct loading of ships. Probably the most ingenious invention for this purpose was the continuous elevator conveyor for packages of medium size and weight. This machine has developed an efficiency little less than marvelous. The limit to the service it will perform is only bounded by the ability of the workers at the receiving end to feed the moving belts and those at the delivery end to receive the packages and stow them quickly and safely away in hold or warehouse.

Careful accounts have been kept of the work of this sort of machine. It has been found that when workmen on the piers become accustomed to its use and learn how to adjust it, it can be got ready for operation within twenty minutes after the ship ties up to the wharf. Where gravity conveyors were used to assist in feeding and taking away from the main machine, speeds of 1,500 deliveries of miscellaneous packages, boxes, barrels and bags averaging in weight from 50 to 150 pounds were made per hour. This speed could be kept up for hours at a time, doubling at least the amount of work previously done in that time and reducing in a very marked manner the amount of breakage formerly chargeable to the old crane system for small packages. In this way incidental damage to shipments, which often ran into uncomfortably large sums, has been almost eliminated.

It is said that when operated in conjunction with modern crane hoists for the heavier freight the following advantages have been secured:

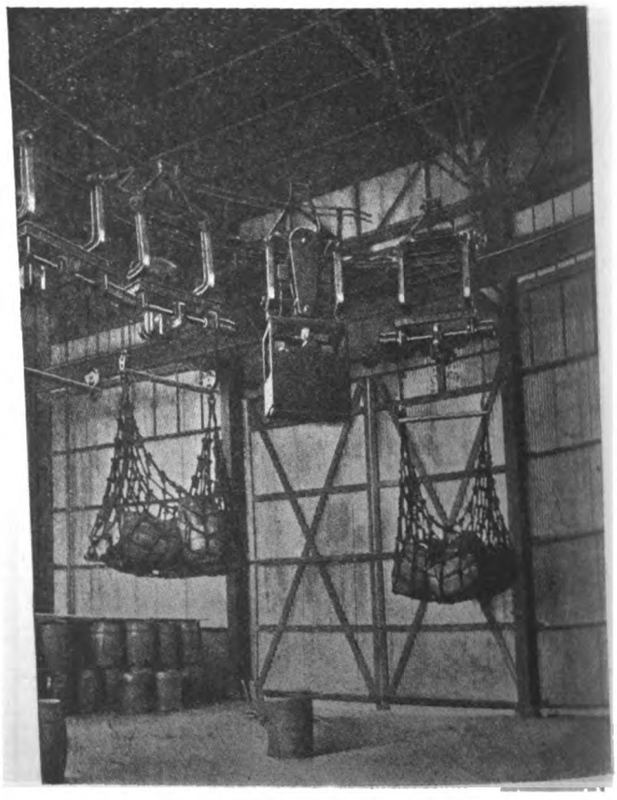
1. Speed of handling ship's cargo within its capacity can be increased from 25 to 75 percent.
2. The amount of labor required can be appreciably reduced.
3. Economy of electric current consumption is effected, most machines operating on 3-horsepower motors.
4. Damage to goods is practically eliminated.

It is interesting to see how one mechanical advance leads to another. The quick unloading of ships at first resulted in great congestion of freight at the end of the gang-planks, unloading machines and crane bases. Under the old hand-truck and hand-lifting method it was impracticable to stack freight higher than five feet from the ground. Stacking machines have now been perfected that stack freight three or four times as high as the old-style hand limit, thus trebling or quadrupling the amount of use that can be gotten from valuable warehouse or pier space.

Another modern freight-handling development is the overhead adjustable loop system. This system is particularly adapted to terminal sheds for the temporary storage of freight or materials before loading or after unloading from ships, barges or railroad cars. The primary purpose of this system is to speed up the movement of freight in the shed, to reduce the cost of handling it, to utilize the shed space to the greatest possible extent, both horizontally and vertically, and to relieve congestion at loading and unloading points.

This apparatus is doing a good deal to combat the inadequate equipment which formerly existed at nearly all marine terminals and which has caused ships to lose such a large percentage of their time in harbors. The time thus lost has recently been estimated by the United States Shipping Board to be 20 to 30 percent, during which the ship earns nothing and keeps other ships away from the dock. Naturally, the most important factor in reducing the amount of time spent by the ship in port is the devising of machinery capable of cutting down the number of operations required and increasing the speed with which goods can be moved.

The limiting factor in unloading ships is the speed with which the cargo handlers on the vessel can get the cargo out under the hatches and attached to the hook of the hoist or crane, or loaded on automatic conveyors. The same holds true when the process is reversed. To get such speed it is necessary to have machinery capable of being at all times able to take away the freight as fast as it is hoisted out of the ship. Such machinery is of various types, but the overhead conveyor has made some unusual records in this connection, especially in places where there is more than the usual amount of congestion and a conse-



Special Electric Telpher for Pier and Warehouse Use

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quent lack of warehouse space for the storage of freight.

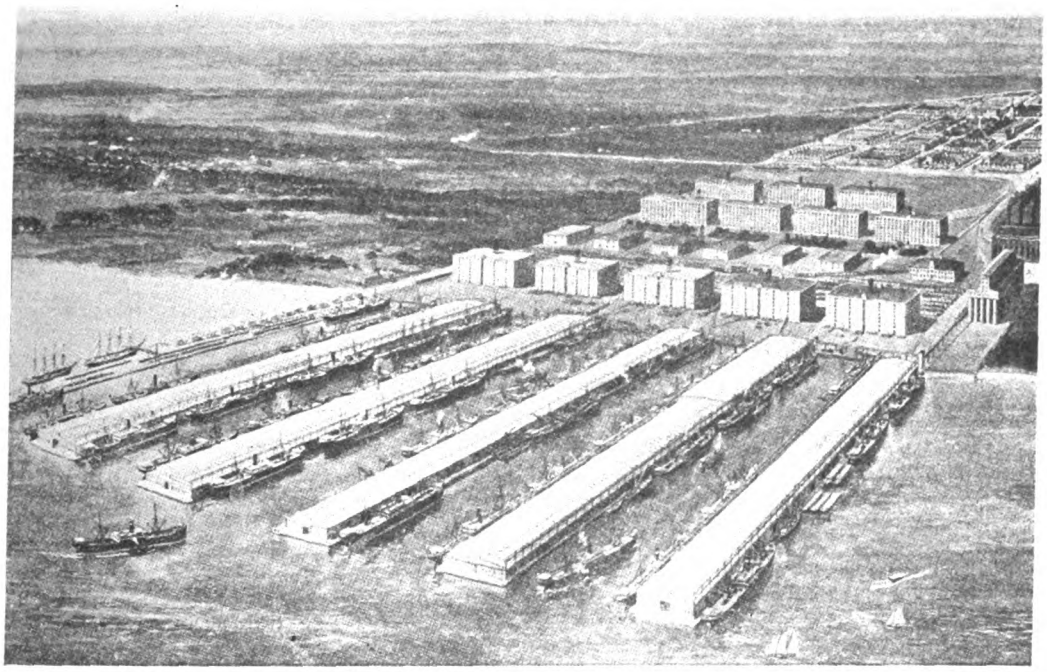
Up to this time, few terminal sheds or warehouses have been fitted with overhead systems, but this device is now making rapid progress, due, largely, to the elasticity it introduces into the other handling devices. As a space saver it is unequalled, because it obviates the necessity for wide aisles for the passage of trucks. The overhead system tiers boxes, barrels, cases and bundles much higher than is feasible by any other means, thus multiplying the value of each square foot of warehouse or shed space.

At the ports where efficient mechanical equipment is already in operation, some remarkable records have been made. Beaumont, which has a port unit regarded by marine engineers as a model of what a port should be, is especially proud of some of the freight-handling work already accomplished at its docks. A recent record was that on March 6, 1919, when 2,103 barrels of asphalt were unloaded in eight and a half hours. The shipment moved at the rate of four and a half barrels per minute, and the total cost to the consignee for the unloading of the entire shipment, which weighed 1,051,500 pounds, was $25.16 (5/4/10).

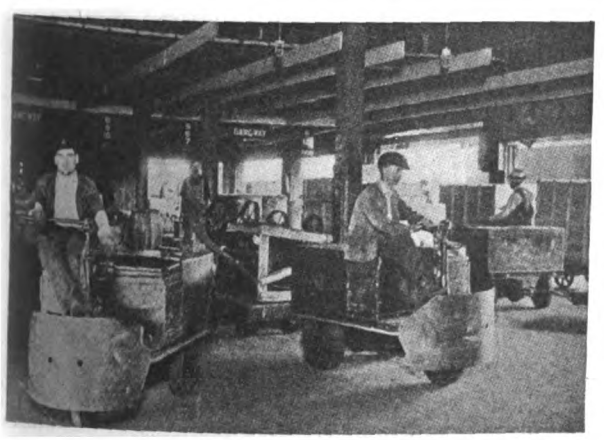
In moving goods greater distances along piers or in warehouses than it is feasible to extend the conveying systems, the storage battery tractor and trailers have now largely come into use. With small tractors able to turn around in their own length, trucks heavily loaded are quickly hauled from one place to another, the whole apparatus being taken on huge freight elevators for removal from one level to another. One operator runs the whole contrivance, superseding a whole gang of stevedores with hand trucks propelled entirely by man power.

Some clever work has been done by the designers of cargo-handling machinery in making it adjustable to tide variations. Although the tide is not a very important factor in New York harbor, there are a number of American ports where it has to be given careful attention. This introduces the necessity for an amount of flexibility in all such machinery which no other designers have to provide.

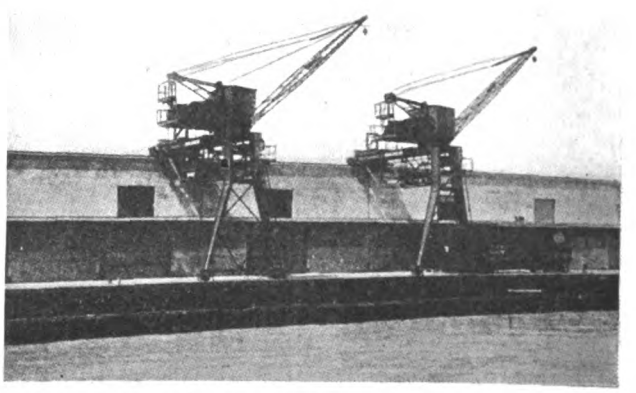
The direct interest of the average exporter in this general question may be stated this way: "Will it be possible to operate the new American merchant marine so economically that, in spite of higher costs all around, rates can be made that will permit competition for American



Municipal Terminal at Norfolk, Now Partially Completed



Electric Tractors and Trailers in Use on Steamship Pier



Electric Crane Dock Equipment at Galveston

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manufacturers in the markets of the world?" The answer, according to the men who are designing the American ports of tomorrow, and who are making the mechanical equipment with which they are to be operated, is "Yes."

There is no doubt that a most optimistic feeling concerning the future pervades the ranks of shipping and mechanical appliance experts. They are certain that the records made in handling coal, ore and oil are going to be repeated with general export cargoes. Labor costs of operating ships will be of small moment if the vessels can be mechanically unloaded, reloaded and coaled in a space of time even one-quarter less than in the ports of Europe.

Equipment of Docks and Warehouses

Equally important with mechanical equipment used in direct connection with the ship is the equipment of the dock and warehouse into or out of which the cargo must be handled. Modern practice in building docks differs radically from that of the past, with the gantry crane the unit around which all else seems to revolve. The crane has demonstrated itself to be the most economical, most flexible and quickest of all machinery used in connection with the handling of general cargo. When the United States was suddenly called upon to equip ports in France with machinery by which a potential army of four million American soldiers could be fed and munitioned, the gantry crane was the instrument chosen for the major share of the work. What can be done in modernizing every American port was vividly illustrated in France. Within a year from the letting of contracts for machinery, long lines of steamers were being unloaded at the army docks at Brest and St. Nazaire at a speed never before approached, allowing ships to get away for the return voyage in hours where in past years they would have required the same number of days.

While New York, through which passed last year 41 percent of the entire foreign commerce of the United States, is far behind in the matter of mechanical port equipment, it has potentialities in this respect far surpassing any other important port in the world. When the work of modernizing the port of New York is completed, freight will be handled at a speed and with an economy that will probably be beyond the reach of any other port. The first tentative work will soon start on the new Staten Island terminals and the construction of the proposed railroad tunnels to connect with them will be the nucleus for a land and water transportation machine capable of handling a fabulous amount of freight in a year.

Free Lighterage Abolished at New York

The abolition of the free lighterage system in New York harbor marked the beginning of the end of the old and costly régime. Railroads formerly furnished free lighterage to all parts of the harbor and included the cost in the line haul charge. The Federal Railroad Administration changed this and ordered separate charges to be made for lighterage service. This change has brought to the front the necessity of substituting direct rail connection for the outworn plans used in New York harbor ever since the days of sailing vessels.

At all American ports where the Railroad Administration has consolidated all railroad terminals in the interest of more economical freight handling, great savings have been effected. These savings have so far been much less at New York than at most other ports because the great barrier formed by the Hudson river between the two main parts of the port has made the continuation of flotation costs a necessity. Possible advantages of the port have thus been spoiled, but the rail tunnels that will inevitably be constructed will change present difficulties into advantages.

It used to be the fashion to point out Antwerp, Bremen, Hamburg and a few other European ports as examples of what a port ought to be. All the machinery used in these ports was made either in Germany or in England. It took the shock of a world war to show what American manufacturers of cargo-handling machinery could do, but they certainly rose to the emergency in splendid shape. The ports all over the world that have sought improved mechanical equipment during the past two years have in every case come to the United States for it. For instance, one American company making nothing but cranes has sold its equipment to the following French ports, to take one country alone: Rouen, Cherbourg, Brest, Dunkirk, Rochefort, Bordeaux, Nantes, Havre, Saint Nazaire, Saint Louis du Rhone, Cette, Marseilles and LaPallice.

Modernized American Ports

Of the American ports that have gone ahead and prepared to bid for their share of the nation's export trade by putting in mechanical equipment, comprehensive warehouse systems and economical rail connections, Galveston and Seattle are undoubtedly in the lead. Ships are now being cleared at Galveston faster than at any other port in the country. The Galveston Wharf Company, operating with the electric wharf cranes, is handling great quantities of cotton, sisal, steel billets, bagging, flour and other commodities and clearing ships in less than twenty-four hours. Seattle is making records closely approaching those at Galveston, although the character of freight handled by trans-Pacific vessels requires longer time for handling than is usually the case at the Gulf ports.

On the Atlantic coast, Norfolk is said by marine engineers to be pushing ahead the fastest. The channel depth at that city is something of a drawback until dredging now under way is completed, but the port itself, when completed, will be a model for the other aspiring seaports of the country.

By means of mechanical loading and unloading devices, a ton of ore is now carried from Duluth to Conneaut for half a dollar. The ships that do this make a profit in spite of the fact that they can only operate eight months in the year, while interest and other expenses run for the full twelve months. Who will believe that if our Great Lakes fleet, paying American wages to seamen, American prices for food and supplies and American salaries to officers, can be run at a profit, the same kind of skill cannot profitably be applied to the problems of ocean transit? Part of the answer is contained in the recent organization of the Association of Material Handling Machinery Manufacturers. Nearly all the important makers of mechanical loading apparatus have joined hands by means of this association for the purpose of putting at the service of American ports the very best technical skill that exists in their industry. The makers of the machinery know what wonders of economy and speed can be effected; all that now remains is to teach our exporters and civic authorities, and the job is done.

The daily papers are often much twisted in their accounts of mechanical happenings. Some years ago an oiler, while he was filling a crank bearing, was killed when the upper end of the connecting rod in a vertical engine struck his head. The papers stated, "The poor fellow got his head in some way into the slot in which the piston works and his skull was crushed between the piston and the cylinder."

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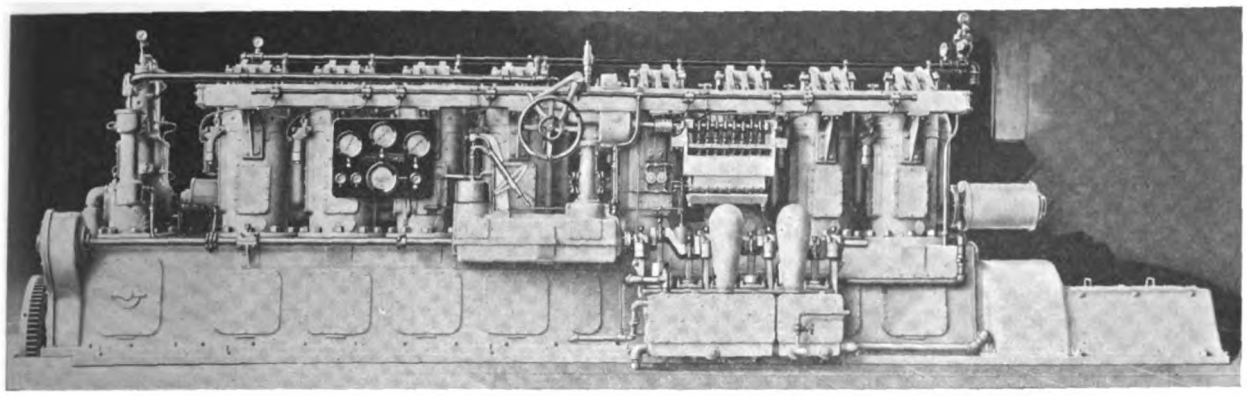

Fig. 1.—Operating Side of Eight-Cylinder Winton Diesel Oil Engine. Bore, 12 15/16 Inches; Stroke, 18 Inches

The Winton Marine Diesel Oil Engine

Detailed Description of Construction and Operation of Diesel Type Marine Engine Manufactured by Winton Engine Works

THE first Diesel engine designed and built by Alexander Winton at the Winton Engine Works, Cleveland, Ohio, was that type which at the time seemed to fill the greatest demand; that is, an engine for an auxiliary schooner or a vessel having a carrying capacity up to 4,500 tons. This meant an engine of compact design and of comparatively high speed and one that could endure this work for a long period of time. This type also lends itself to production in a large manufacturing plant, and in three years of service at sea, both in auxiliary schooners and full-powered motorships, has proved itself both reliable and economical.

One of a number of examples of Winton-equipped ships that has come to light recently is the *James Timpson*, which lately completed a 14,500-mile voyage, equipped with two six-cylinder Winton Diesel engines, operating at comparatively high speed and back-geared to the propellers through reduction gears. But this is only one of a half dozen or dozen other similar cases, although all different installations; and probably by the time this article

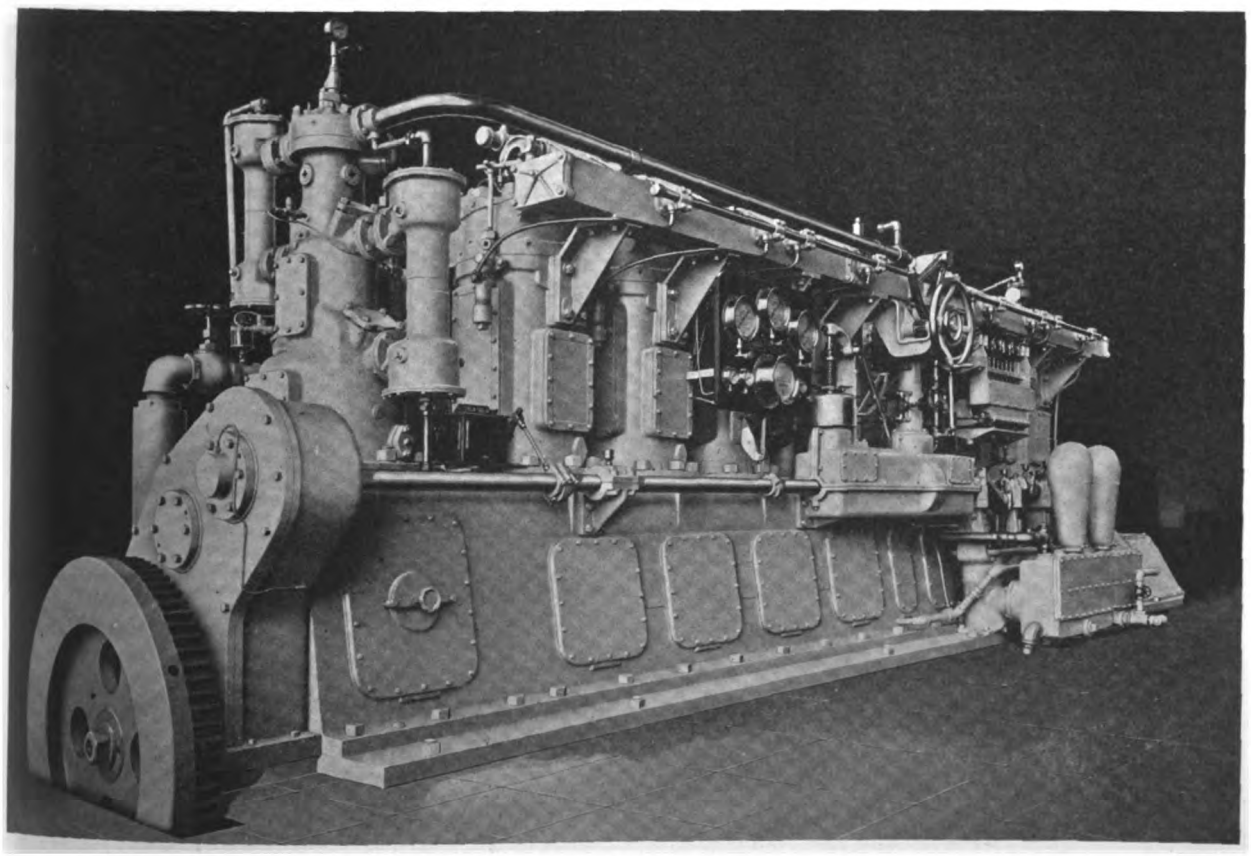

Fig. 2.—Quarter View of Operating Side of Eight-Cylinder Winton Diesel Oil Engine Model W-40

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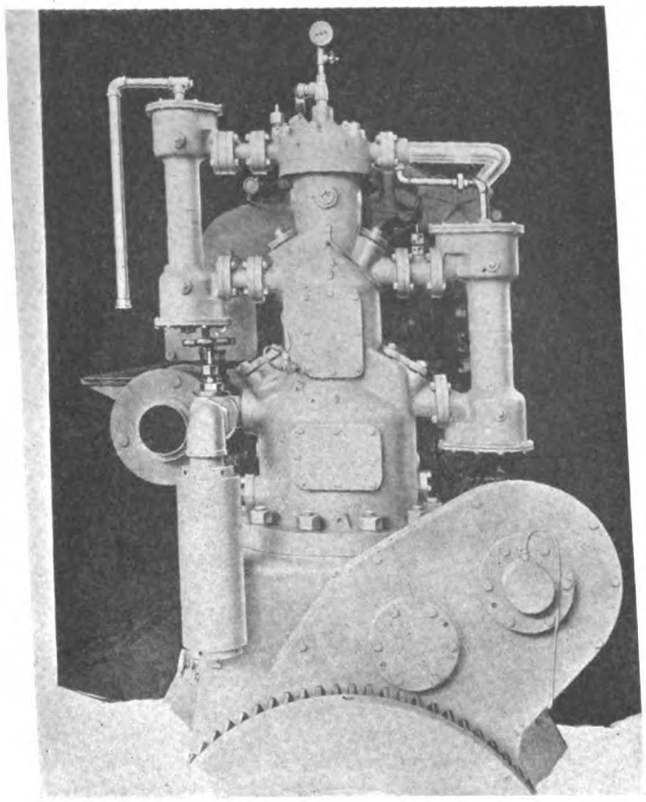

Fig. 3.—End View of 12 15/16-Inch by 18-Inch Engine, Showing Air Compressor

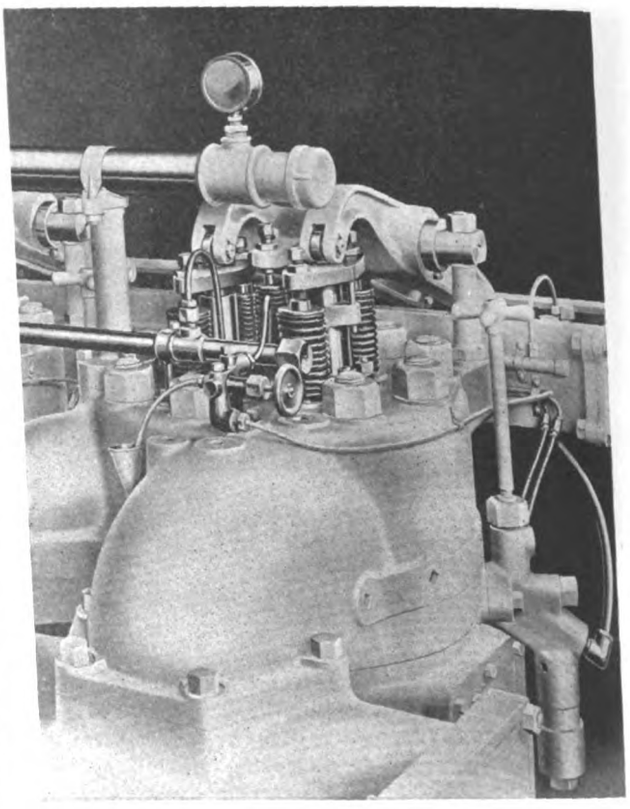

Fig. 6.—Completely Assembled Cylinder Head, Showing Valve Operating Mechanism and Fuel Injection Pipes

is in the reader's hands these same vessels will have added another twelve to fourteen thousand miles to their present logs.

There is naturally at this time widespread public interest in the development of shipping to sail under the American flag. There is not, however, equally widespread knowledge of the economies to be effected by the use of the heavy oil Diesel engine in place of the orthodox steam plant. These economies are two-fold; first, largely increased carrying capacity of a given size ship, due to the much smaller space requirements of the power plant, and, second, the greatly decreased operating cost.

Economies Effected by Use of Diesel Engines

Space saving is effected in several ways. The engine room proper is about the same size in either case, but with the Diesel engine the boiler room is entirely eliminated, as are also the coal bunkers, the oil fuel being stored in the double bottom, or in tanks occupying much less space than the bunkers. The crew's quarters are also much smaller.

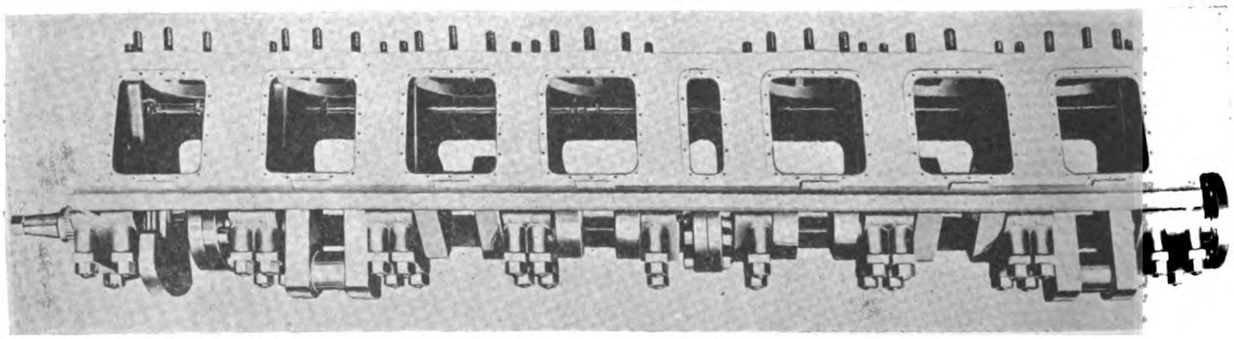

Fig. 4.—Upper Crank Case, Showing Method of Bolting Crank Shaft to Top of Case Instead of to the Bottom

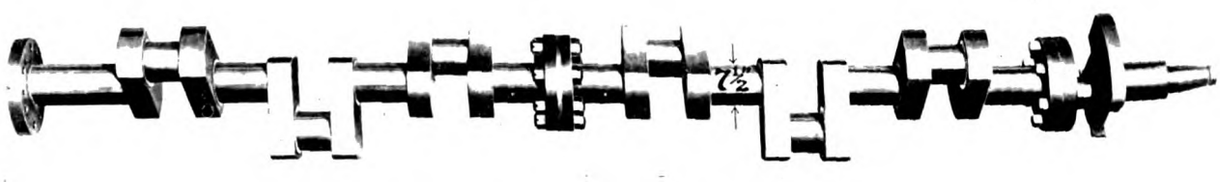

Fig. 5.—Six-Cylinder Crank Shaft of Winton Diesel Oil Engine

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as there is, of course, no boiler room force, and the engine room force is considerably reduced. The net carrying capacity of a 3,300-ton ship, 250 to 260 feet long, powered with two of these Diesel engines, is increased 15 percent over that of a ship with steam as motive power. But a few moments' consideration is required to realize the vast advantage given by this increased capacity, even if the operating costs were not reduced. Particularly is this true in view of the recent reductions in rates for ocean cargoes.

Reduced operating costs result from three sources, viz., cheaper fuel, smaller operating force, and less time required for a given voyage. The total cost of fuel oil is only about one-third that of coal. Roughly, about one-sixth as much deadweight of oil fuel is required as of coal, while the cost of oil is about twice that of coal per ton. The saving of man power, and consequently of living expenses during the voyage, is due to the elimination of the stokers and a reduction of perhaps one-third in the engine room force. In one case recently reported by Edward N. Hurley, chairman of the United States Shipping Board, the reduction was from 33 men on a steamer to 23 men on a motorship of the same size.

The saving in time results from the much smaller number of stops required for bunkering, and also because of the shorter time needed to pump the oil aboard as compared to that for loading an equal weight of coal. The figures as given by Chairman Hurley in the case mentioned above are as follows: The steamer stopped 14 times for coal in a voyage lasting 300 days. The motorship stopped twice in the same distance for oil, completing the voyage in 236 days, besides using some of her tank capacity for carrying a cargo of oil from one port to another.

The figures given above are by no means exceptional, as many records of even greater performances are on file. In addition to the above, there are many other advantages of the motorship over the steamer, which make its adoption desirable except perhaps in the largest ships.

Distinctive Features of the Winton Engine

The majority of the Diesel engines built in the past for motorships have either been constructed abroad or built in this country under foreign patents. These have usually been of the open crankcase, crosshead type, following accepted marine practice in the case of steam engines. Among the few strictly all-American designs, the Winton engine stands out because of its departures from the conventional accepted forms. That these departures have been in no way detrimental is proven by the successful records established during the past two years on many ships; on the contrary, they have permitted the construction of very light, compact units, running at higher speeds than have yet been generally accepted, and with sufficient reserve power for all emergencies.

Winton engines have been produced in the following three sizes:

Six-cylinder, 11 inches by 14 inches, known as Model W 35.

Six-cylinder, 13 inches by 18 inches, known as Model W 24 A.

Eight-cylinder, 13 inches by 18 inches, known as Model W 40.

Ordinary practice in the past in producing moderate-powered Diesel engines has been to copy the designs used in marine steam engines which the Diesel engines are to replace. This has resulted in clumsy designs, the extraordinary features being adopted with the idea of overcoming the expected prejudice of the engineer accustomed only to steam engines.

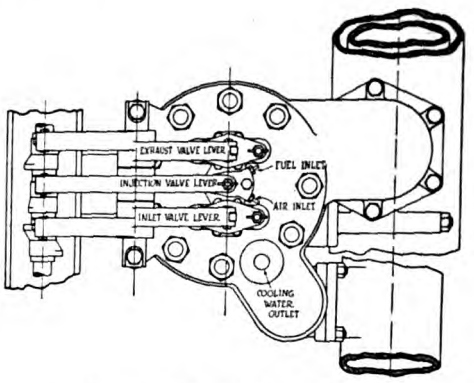

Fig. 7.—Plan of Cylinder Head

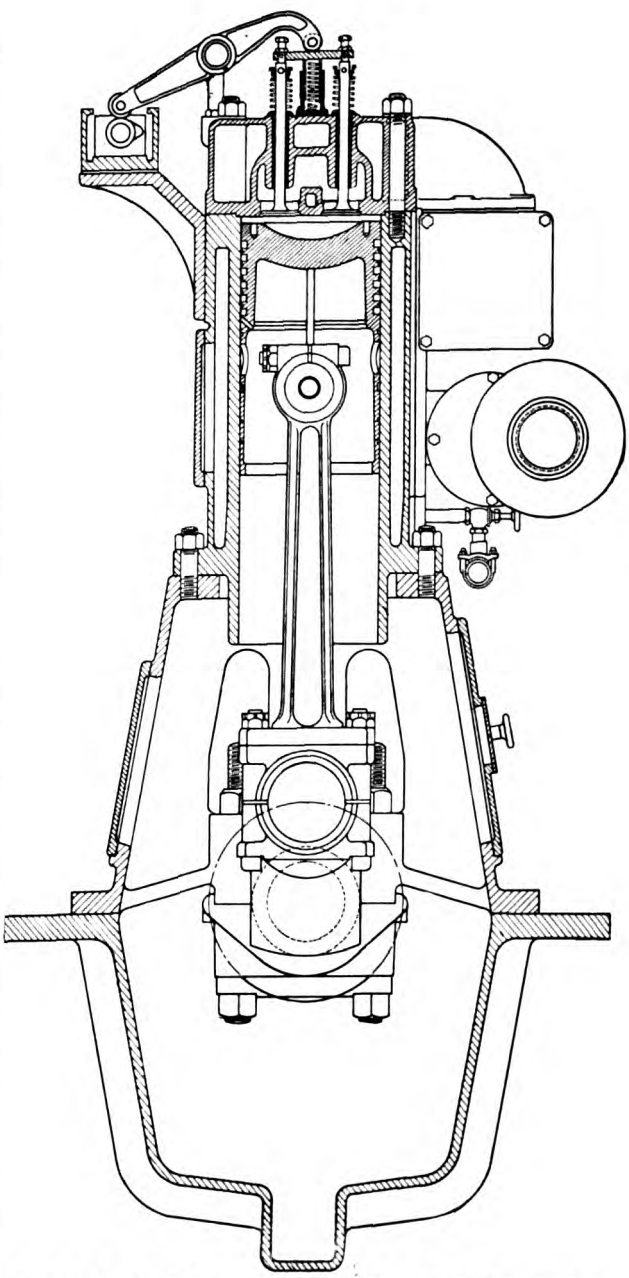

Fig. 8.—Sectional View of Cylinder and Details of Fuel Injection

In designing his engines, Mr. Winton departed greatly from this practice, and applied the proven principles of standard practice wherever they logically could be used. The outstanding features of his engine are: The use of

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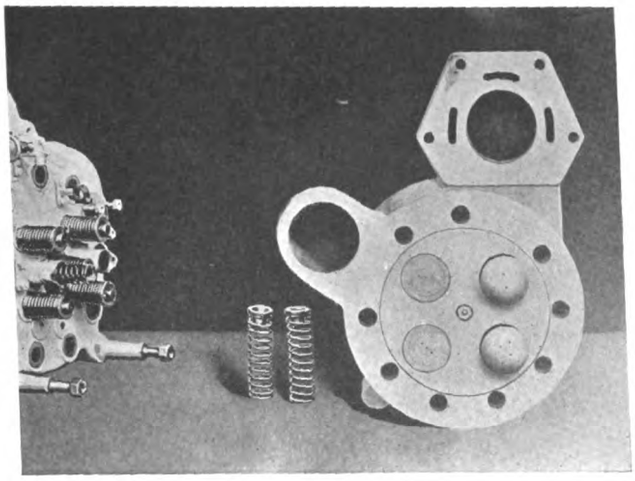

Fig. 9.—Part of Cylinder Head Construction

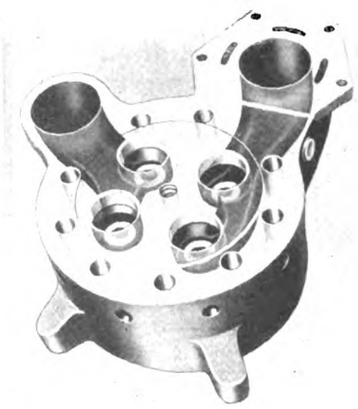

Fig. 10.—Phantom View of Head

an enclosed crank case, trunk pistons instead of the usual crosshead arrangement, and crank shaft bolted up to its bearings, which are mounted in the upper half of the crank case.

Method of Mounting Crank Shaft

This method of mounting the crank shaft, which is practically universal practice in gasoline (petrol) engine design, has two very important advantages. It is well understood that practically all the wear which takes place in main bearings is in the lower halves, as the thrust is in this direction in the power strokes. As wear takes place, the crank shaft drops slightly from its original position. If the wear is unequal in the various parts, the result is that the shaft is sprung more or less out of line, straining the shaft and reducing the effective output of the engine.

Where the lower halves of the bearings are fixed and the upper halves are bolted down to them, it is very easy in taking up loose bearings to spring the shaft seriously out of line. It is almost out of the question to lift the heavy shaft off its bearings to get at the lower halves; and, further, it is very difficult to determine when the bearings are exactly in line. On the other hand, if looseness develops where the shaft is bolted up to the fixed upper halves of its bearings, taking up the looseness simply restores the shaft to its original alinement.

The second real advantage of this mounting is that taking up wear in the bearings brings the pistons up to their original position again, so that the compression remains unchanged. Where the shaft is bolted down to its bearings the wear which inevitably takes place permanently reduces the compression. Naturally, the engine will operate most satisfactorily under the conditions for which it was designed and built.

Air Compressor

In Diesel engines the fuel is forced into the cylinder, against the compression, by compressed air at 850-950 pounds pressure. The high-pressure air for this purpose is obtained from the air compressor at the forward end of the engine. This cylinder is a three-stage air compressor. The piston is of the trunk type and is operated by a connecting rod, which is a duplicate of the connecting rods in the power cylinders, and a single-throw counterweighted crank shaft which is bolted to the front end of the main crank shaft. The throw of this single crank is somewhat less than that of the power shaft. Following each stage of the compression the air is water-cooled, so that on delivery it is at normal temperature.

The capacity of the air compressor is considerably in excess of that required for the injection of the fuel into the cylinder, providing for the initial charging and the maintenance of pressure in the storage tanks, or air bottles, which are used for starting the engine. There are two sets of these air bottles, one carrying air at about 600 pounds pressure per square inch, for starting the engine, and the other carrying air at 1,000 pounds pressure per square inch fuel injection.

Construction of Crank Case

The crank case is of gray iron, cast in one piece, of skeleton construction; that is, the sides have large openings opposite each throw of the crank shaft, each of which is provided with a cover plate, affording easy access to all parts of the interior. A main bearing for the crank shaft is provided on each side of each throw of the crank shaft, each bearing being supported by heavy ribs. The lower part of the crankcase is enclosed by a trough-shaped casting which extends from the timing gear in the front to the rear of the thrust bearing at the back end of the engine. The crank shaft and connecting rods are thus fully enclosed, so that there is no possibility of oil being splashed outside of the engine.

The bearing caps are each bolted up to the crank case by four large studs and nuts. The bearings themselves

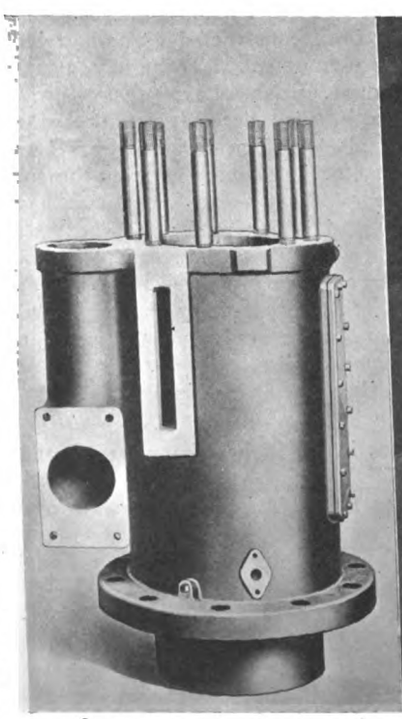

Fig. 11.—Cylinder, Showing Bolts for Attaching Head

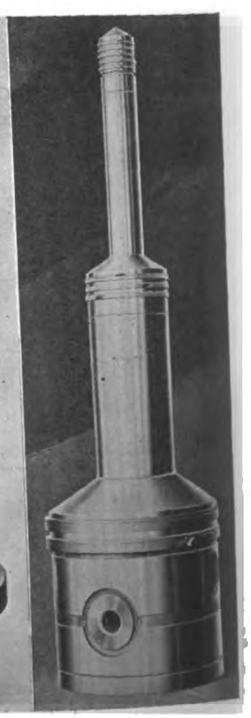

Fig. 12.—Piston of Three-Stage Air Compressor

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are heavy shells, lined with high quality babbit metal. Each bearing has an individual oil lead from a header running the full length of the crank case. This header is connected to a two-cylinder reciprocating oil pump which maintains constant oil pressure on the bearings. Further details of this pump will be given later.

Crank Shaft Built in Three Sections

The crank shaft, because of the considerable weights and sizes of the forgings involved, is made in three pieces, two sections each having three or four throws for the power cylinder and a single throw section for the air compressor. These sections are flanged and bolted together before being assembled into the crank case.

From each main bearing of the shaft, a hole is drilled through the adjacent web to the crank pin. These holes register with grooves in the main and connecting rod bearings, so that the connecting rod lower bearings are also lubricated under pressure directly from the pump.

The connecting rods are I-section forgings, split at the upper end and clamped around the piston pins, and formed into a T-head at the lower end, to which two half-boxes and a supporting cap are bolted. Each rod has an oil-tube connecting with the groove in the upper half-box and leading upward to the piston pin. The piston pin itself is hollow with its ends plugged, and is drilled near each end so that oil is fed directly to the bushings in the piston. The tube and piston pin are thus filled with oil under pressure from the pump, thus lubricating the piston pin. The piston pin is case-hardened and ground, and bears on bronze bushings pressed into the bosses in the piston.

These piston pin bushings are grooved so that the oil will reach all the pin bearing surfaces. The surplus oil escapes onto the cylinder wall, providing lubrication for the pistons. Any excess oil works down and collects in the crank case. It is thus seen that all bearing surfaces are provided with positive lubrication.

Trunk Pistons

The trunk pistons are about 75 percent greater in length than in diameter. The piston pin bosses are located about one-third of the distance up from the bottom of the piston, which brings them to about the center of the effective bearing surface. The length of the bosses is such that the bronze bushings can be inserted from the inside. As each bushing is flanged, it is effectively locked against endwise motion when the connecting rod is in place.

The piston has the usual saucer-shaped top to give the necessary compression space, there being heavy ribs from its top to the side walls and the bosses. The piston is also strengthened by a rib around the inside, just above the bosses. To prevent oil from splashing up under the lower side of the head where it would be burned, the hole

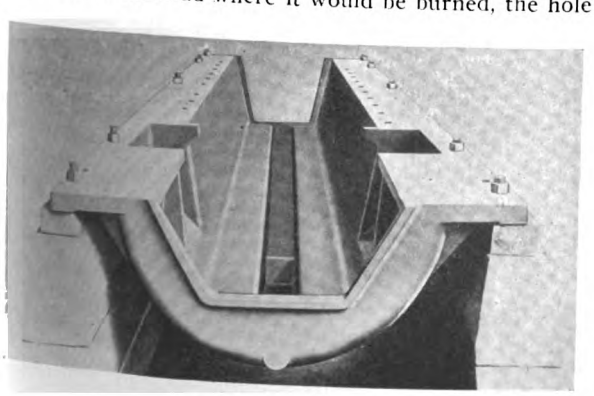

Fig. 13.—Lower Crankcase

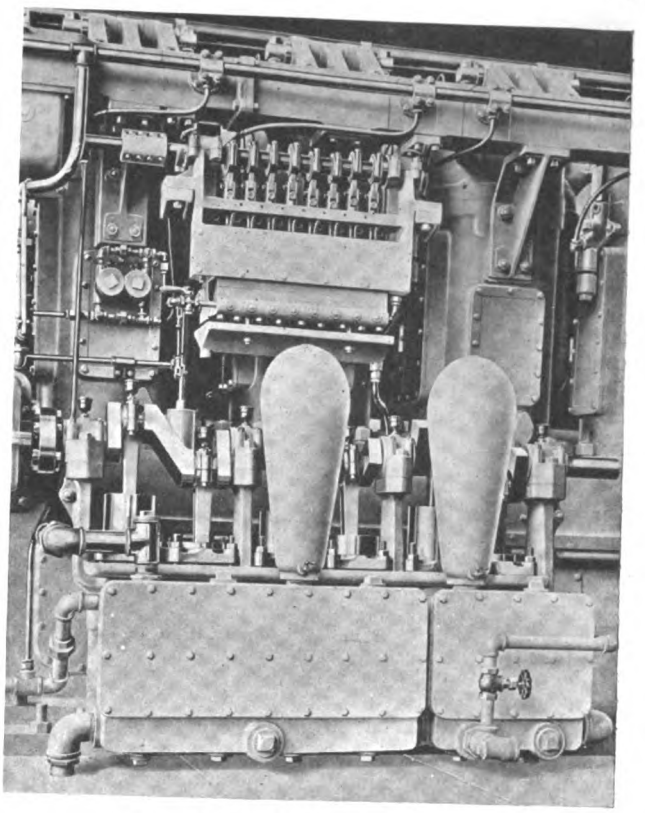

Fig. 14.—Oil Pump and Fuel Pump

through this rib is closed by a light sheet metal plate. This simple feature, it is claimed, has great influence in maintaining the quality of the lubricating oil, which would otherwise rapidly become very dirty. The usual piston rings are carried at the upper end of the piston. To prevent oil working up past the piston rings, a groove is turned immediately below the lowest ring, and from this groove a number of holes lead back into the inside of the piston.

To permit the handling of the bolt which clamps the upper end of the connecting rod around the piston pin, each piston has a hole through each side midway between the pin bosses and slightly above them.

Cylinders

The cylinders are cast individually with integral water jackets, there being large cover plates so that the jackets can be readily cleaned out if necessary. The cylinders are bored and then ground to very close limits, to secure an excellent fit of the piston and rings.

The cylinder heads are attached to the cylinders by studs and nuts so arranged that the pressure is uniformly distributed. Each head carries five valves, two for the incoming air, two for the exhaust, and one for the injection of the fuel. Each pair of inlet and exhaust valves is operated from the crankshaft by a single rocker arm, the valves being connected by a T-head guide on which the end of the rocker rests. The guide is carried in contact with the rocker at all times by a coil spring in the center of its hollow stem. Each end of the guide carries an adjusting screw and locknut, by which the clearance between the ends of the valve stem and slide can be adjusted. This clearance should be about .015 inch for both main inlet and exhaust valves. These pairs of valves are used instead of single large valves, as the small valves are much less apt to warp under the high temperatures to which they are exposed.

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The fuel injection valve is located in the center of the head, and is also operated by a rocker from the camshaft. The adjusting screw for this valve is set to leave .025 inch clearance when the valve is closed. All these clearances are those for a cold engine, and will be somewhat less as the engine warms up.

FUEL INJECTION VALVE

High-pressure injection air flows during all the time the injection valve is open. Fuel is injected, however, during part or all of this period, depending on the amount of power required from the engine. The amount of fuel is controlled by a centrifugal governor which limits the duration of the fuel pump suction as may be required to maintain the engine speed.

FUEL PUMP

The fuel pump is of the plunger type, with one plunger for each power cylinder. It delivers the fuel to the fuel injection valve under a pressure of 850 to 950 pounds, depending upon the pressure of the fuel injection air. The stroke of the fuel pump is constant, the amount of fuel delivered being controlled by the governor, by the early or late closing of the pump inlet valve as noted above. The action of the governor is very delicate, as the speed variation with varying loads is very slight. This is, of course, a great advantage in a marine engine on which the loads may vary from one extreme to the other as the ship's propeller is deeply submerged or approaches the surface of the water in rough weather. The fuel oil is lifted to the fuel pump from the tanks by air at 10 to 15 pounds pressure.

The engine cylinders and air compressor are provided with circulating water by a 4-cylinder plunger pump, operating from the same crank shaft which handles the oil circulating pump.

OIL CIRCULATING PUMP

The oil circulating pump, which provides lubrication for all the main bearings of the engine, really consists of two single-cylinder pumps. The one driven from the end throw of the crank shaft operating the circulating water and lubricating oil pumps draws the oil from the pump in the lower half of the crank case and forces it through a cooler and a strainer to a storage tank. The other single-cylinder pump draws the oil from this storage tank and forces it into the header, from which it is piped to the bearings, as described above. The discharge side of the pump is provided with an air chamber to insure constant pressure being carried on these bearings. The circulating water pump is of the four-cylinder type and also has an air-chamber on the discharge side to insure steady circulation of the water. The cylinders, pistons and stuffing box glands are made of non-corrosive bronze to prevent injury by the water.

The camshaft is supported in a long box-shaped casting open at the top, which is in turn supported on brackets from the cylinders. This trough is partly filled with oil, for lubricating the cams: the camshaft bearings are lubricated under pressure from the pump, as are its driving gears.

The camshaft is driven by bevel gears from a vertical shaft near the center of the engine, which in turn is driven from a lay-shaft and a train of spur gears at the front end of the engine.

ACTION OF CAMS

The camshaft is provided with two complete sets of cams, for forward and reverse motion, respectively. Shifting the shaft endways by means of a handwheel and suitable mechanism brings either set of cams into operation. The shift from full speed ahead to full speed astern is guaranteed in six seconds, and is frequently accomplished in five seconds.

The procedure required to reverse the engine is as follows:

1. Close fuel oil supply valve.
2. Shift camshaft.
3. Open fuel oil supply valve.
4. Open valve controlling starting air.
5. Close starting air valve.

The supply of air for starting the engine is carried in steel air bottles which are from 12 to 18 inches in diameter and 10 to 20 feet long. These are stored wherever convenient on the ship and connected by heavy brass tubing to a header running the full length of the engine. At the point where the pipe from the air bottles joins this header, is located a valve which can be opened by pulling on a long handle. This admits the air to the header. Each cylinder is connected to the header by means of a pipe in which is located a valve operated regularly by the camshaft. The end of this pipe, connected to the cylinder, is fitted with a special casting containing three valves. The first is a check valve, to prevent the compression or power stroke pressure from escaping from the cylinder. The second is an overload or safety valve, which is set to open if the pressure in the cylinder exceeds normal power stroke pressure. A valve of this type is necessary to prevent damage to the cylinder or piston in case water or oil should accidentally collect in the cylinders. If this happens and the engine were started, the top of the piston would probably be broken out, as water or oil is practically non-compressible. The third valve in this casting is operated by a small handwheel and is opened only when it is desired to attach an indicator to determine the work being done by the cylinder.

The air inlets for both the air compressor and the main cylinders are connected to a large header, into which air is taken through a muffler at each end. This arrangement of drawing air for the engine directly from the engine room has the decided advantage of constantly drawing fresh air into this room, thus insuring ventilation.

THRUST BLOCK

The thrust block at the rear of the engine has one unique feature, in that the thrust surfaces are lubricated under pressure from the engine oil pump. This thrust block consists of a short, heavy shaft, flanged at both ends, one flange being bolted to the rear flange on the crank shaft. Turned integral with this shaft are a number of large collars, between which the horseshoe-shaped thrust segments are mounted. Each of these segments is faced with babbitt on both sides and has a connection at the top to an oil lead from the pump. The babbitt facings are grooved so that the oil is distributed under pressure over the entire thrust surface. The segments are held in the proper position by nuts or heavy threaded shafts along each side of the thrust block. They are consequently readily adjustable for wear. They also are reversible, so that should the babbitt wear or burn off on one side, a new bearing surface can be brought into operation by a few minutes' work.

In general, the design has been very carefully worked out. The best of materials have been selected for each part, and the workmanship is excellent. All these factors contribute to obtain the excellent results which are reported each time a Winton-engine-equipped ship reaches port.

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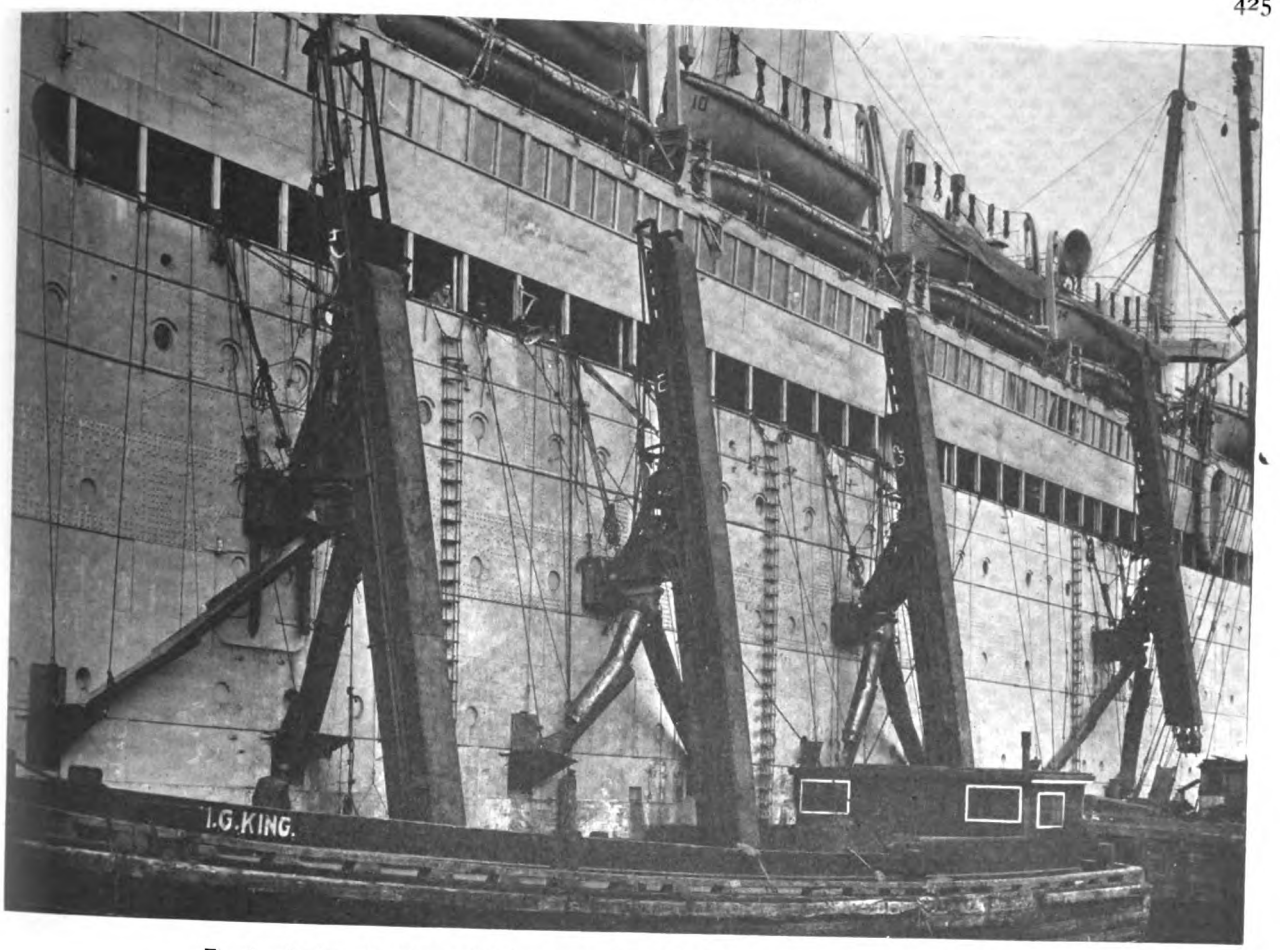

Fig. 1.—Coaling the *George Washington* in New York Harbor with Michener Elevators

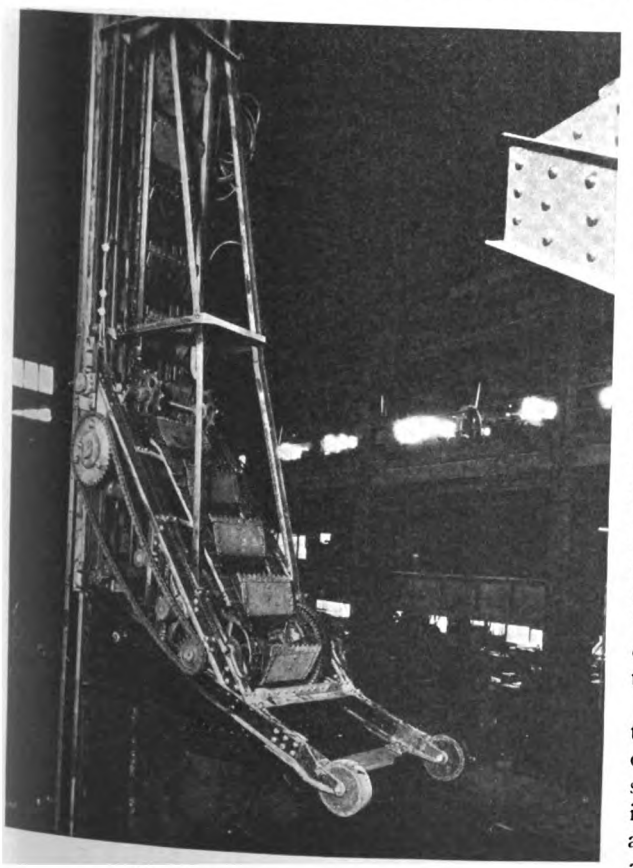

Fig. 2.—Michener Coal Elevator

Mechanical Coaling Apparatus Used on Large Liners

WITH the introduction of large vessels for ocean transportation, the old bucket-and-hoist method of raising coal from the barge to the coal-port became obsolete. In its place has been developed an efficient mechanical apparatus for filling the ship's bunkers without interfering with cargo handling or causing unnecessary disturbance. At the port of New York the Michener apparatus, manufactured by the Michener Storage Company, 17 Battery Place, New York, has been extensively used for this purpose.

The most conspicuous unit of this apparatus is the elevator, a portable machine, electrically driven and controlled, which is capable of raising coal from the barge situated at the ship's side and delivering it in a continuous stream to one or more side-ports, or overhead to a deck-hatch of the ship. Where cross-bunkers are available, the apparatus is well adapted for use on the off-side of the ship, in connection with the Michener trimming mechanism, although it will serve equally well on both sides. The elevator includes the head, in which is installed a driving motor, and the leg, which slides vertically through the head and is adjusted by raising or lowering, as desired.

The conveyor is of the endless chain and bucket type, the buckets engaging the coal at the foot of the leg. In operation the elevator is suspended from the side of the ship at any desired location by the head. It is maintained in this position by tackle attached to the deck or other available portion of the ship. The machine, which weighs about 13,000 pounds, is readily hoisted into place. The elevator, which is electrically driven by a ten-horsepower

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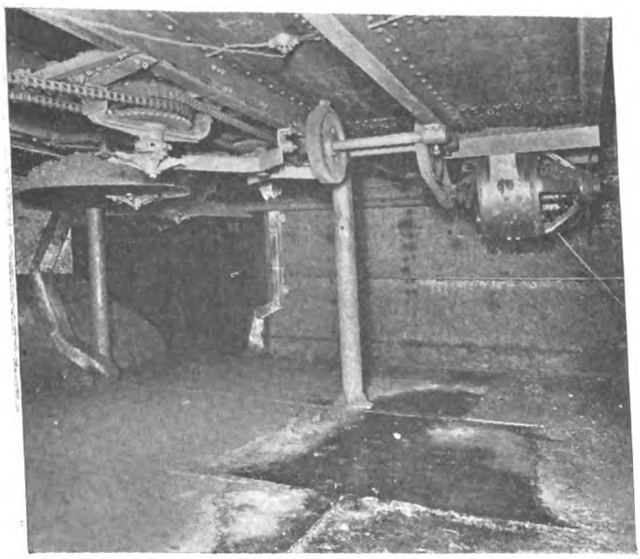

Fig. 3.—Bunker-Trimming Mechanism, Showing Disks, Plows and Attached Motor

Fig. 4.—Series of Disks for Transferring Coal in Bunkers. Part of Disk Removed to Show Mechanism

motor, may be controlled by one man from the controller's box on the ship's deck or at some other convenient location. The motor and controller may be equipped for any specified voltage and for alternating or direct current.

The leg, which is provided with a safety device to prevent it from falling during operation, may be raised or lowered at the will of the operator. The apparatus is also guarded by a metal cover, so that the coal cannot drop upon the men stationed in the barges below.

Mechanism in Operation

In operation, the leg is raised sufficiently to allow a barge to move under it (see machine at extreme right in Fig. 1) and is then lowered into the coal. While the leg is being lowered the bucket chain begins to operate. The descent is gradual and automatic, so that, as soon as the apparatus touches the coal, the buckets fill and begin to elevate the coal to the ports. This descending movement is governed by a ratchet and pawl, which controls the leg while it is being lowered, allowing the ratchet to run ahead of the pawl when the leg reaches the coal.

The weight of the leg aids in the digging action of the apparatus. Should the resistance against the downwardly moving buckets, however, prove too great, the chain will automatically raise the leg and relieve the congestion.

The delivery point of the coal is established by the position of the head, which is adjusted high enough above the port into which delivery is to be made to allow a free run of coal down the chutes. Since the coal is only carried as high as the head, coal breakage, dust and unnecessary lifting are eliminated. At the moment of delivery, the bucket chain takes a horizontal course in the head, dumping the contents into the two-way discharge pipe, as illustrated. By means of a gate in this two-way nose, the coal may be delivered to either right or left chute. Other adjustments are possible with the apparatus.

Bunker-Trimming Mechanism

A special trimming mechanism is permanently installed in the ship's bunkers which automatically conveys the coal to all parts of the bunkers, piling it up between the deck-beams and heaping it up about the mechanism, so that every inch of available bunkerage space is filled.

By means of deflectors or plows, shown in the illustration, the coal is transferred from disk to disk. It may be noted that a part of the disk has been removed to show the mechanism more clearly in Fig. 4. Details of the motor and transmission gearing, and the sprockets and chains for driving the disks, are clearly shown. In the illustration the coal has been entirely removed from the bunker except for the slight amount which remains on the disks and framework, showing how evenly the disks are heaped with coal at the completion of the operation of trimming.

Capacity of the Apparatus

In actual installation, each unit, handled by one man, delivers 125 tons per hour. The disk-trimming mechanism will transfer about 150 tons of coal per hour from any port, or 50 tons in excess of the amount which the elevators can deliver under average conditions.

Large Wrecked Steam Engine Cylinders Restored by Oxy-Acetylene Welding

BY L. M. MALCHER*

THE following account should prove of more than usual interest to shipbuilders for two reasons—first, because much of the machinery found in shipyard shops and on large vessels is of massive construction like the broken castings referred to below, and, second, because the happenings in a steel mill—the shipbuilders' main source of supply—are of vital concern to the shipbuilder.

One of the big steel rolling-mill engines at the Farrell works of the Carnegie Steel Company, Farrell, Pa., that had been doing its full share in helping to win the war, broke down two weeks after the signing of the armistice, having worked constantly up to then on 100-percent war orders. In the accident, besides other parts, the left-hand low-pressure steam cylinder, 70 inches inside diameter, of an Allis-Chalmers twin-tandem compound reversing engine was badly fractured, as a result of the breaking of a connecting rod at the moment of reversal.

A serious situation confronted the officials of the Carnegie Steel Company, as it would have taken at least three to three and one-half months to obtain a new cyl-

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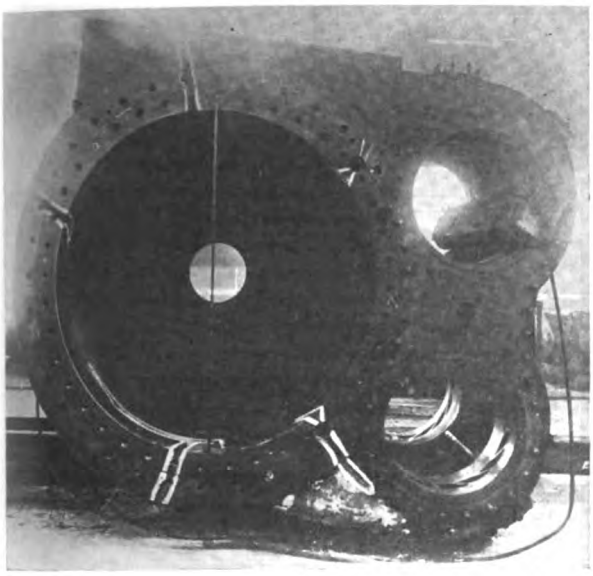

Fig. 1.—Wrecked Low-Pressure Cylinder, Showing Cracks V-Grooved by Chipping Preparatory to Welding. The Seven Cracks, All at Head End, Ranged from 1 to 8 Feet in Length and 2¼ to 3⅜ Inches in Depth

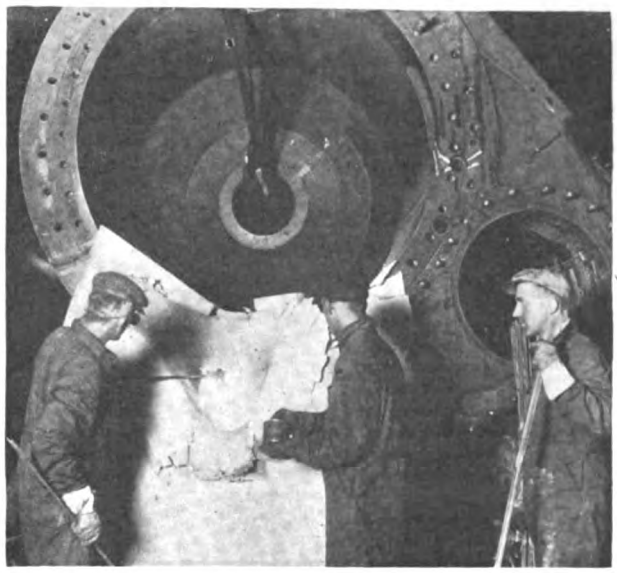

Fig. 3.—Welding the Low-Pressure Cylinder. Asbestos Paper Used to Protect Workers and Retain Heat from Preheating Fire. Extra Long Blow-Pipes and Rods Required for Welding Up the Long Cracks

inder, in case the broken one could not be repaired in a shorter time. Three hundred and sixty men were thrown out of employment. The broken cylinder was of such size and the damage done was of such character that a decision as to whether the cylinder was to be renewed or repaired involved a risk on the part of the management. Although considerations of expense as between the cost of purchasing a new cylinder and repairing the old one were of secondary importance, the cost of repairing was estimated to be about one-third that of a new cylinder.

The officials of the Carnegie Steel Company, after careful investigation, quickly decided in favor of oxy-acetylene welding. They called upon the job welding shop of the Oxweld Acetylene Company, Chicago, Ill., to meet the emergency. Three expert welders, accompanied by all the necessary equipment, went immediately to Farrell and completed the job under the direction of the writer. The total time consumed in repairing the low-pressure cylinder, including chipping, pre-heating and welding, was seventy-two hours. While dismantling the engine, a fracture 42 inches in diameter was discovered in the right-hand high-pressure cylinder. This fracture also was repaired in about eighteen hours. It took just seven days from the time the order was given to the Oxweld Acetylene Company to complete the entire job.

The data covering this work are given below:

LOW-PRESSURE STEAM CYLINDER

5,000-horsepower Allis-Chalmers twin-compound reversing engine. The horsepower given is the maximum power developed while rolling and running at about 100 to 110 revolutions per minute.

Cylinder bore	5 feet 10 inches
Stroke	4 feet 6 inches
Weight of cylinder	13 tons
Thickness of iron casting	2¾ to 3⅜ inches
Number of cracks (see Fig. 1)	7

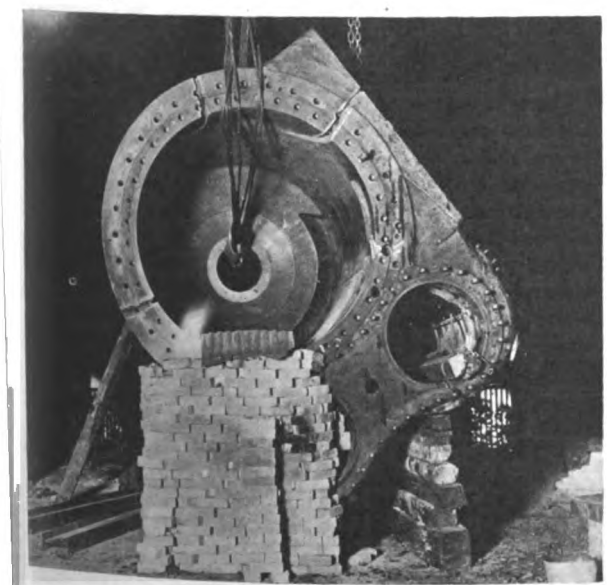

Fig. 2.—Preheating Crack in Low-Pressure Cylinder by Means of Charcoal Fire. Castings Handled by Crane

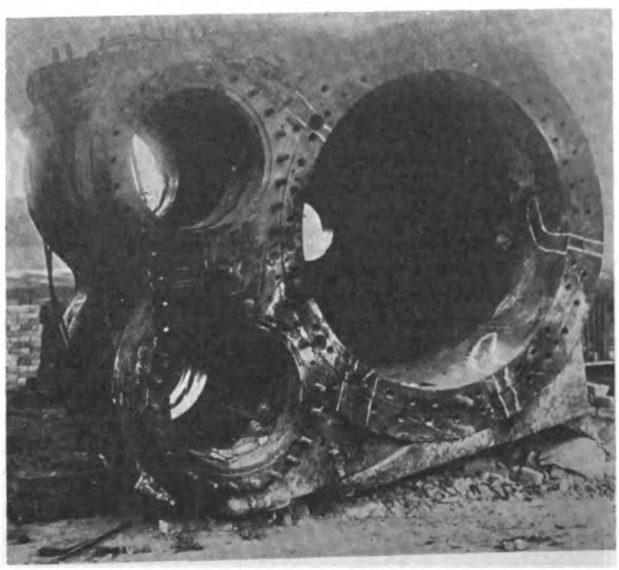

Fig. 4.—Welding of Low-Pressure Cylinder Completed, Casting Fully Restored

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Total length of all cracks	22 feet 2 inches
Preparing and pre-heating casting	27 hours
Welding casting	45 hours
Linde oxygen consumed	2,850 cubic feet
Prest-O-Lite acetylene consumed	2,845 cubic feet
Oxweld cast iron welding rods	390 pounds
Oxweld "Ferro" flux	25 pounds
Number of welders	3
Period of welding shifts	10 to 30 minutes

HIGH-PRESSURE STEAM CYLINDER

5,000-horsepower Allis-Chalmers twin-compound reversing engine.

Cylinder bore	3 feet 6 inches
Stroke	4 feet 6 inches
Weight of cylinder	5 tons
Thickness of iron casting	3½ to 6 inches
Piece of flange broken off (see Fig 5)	
Total length of weld	4 feet 6 inches
Preparing and pre-heating casting	9½ hours
Welding casting	8½ hours
Linde oxygen consumed	650 cubic feet
Prest-O-Lite acetylene consumed	650 cubic feet
Oxweld ¼-inch cast iron welding rods	110 pounds
Oxweld "Ferro" flux	10 pounds
Number of welders	3
Period of welding shifts	10 and 30 minutes

While welding inside of the cylinder castings the men relieved one another every ten minutes because of the extreme heat deflected back on them during the welding operation. On the outside welding, however, the heat was not so intense and the men relieved one another every thirty minutes.

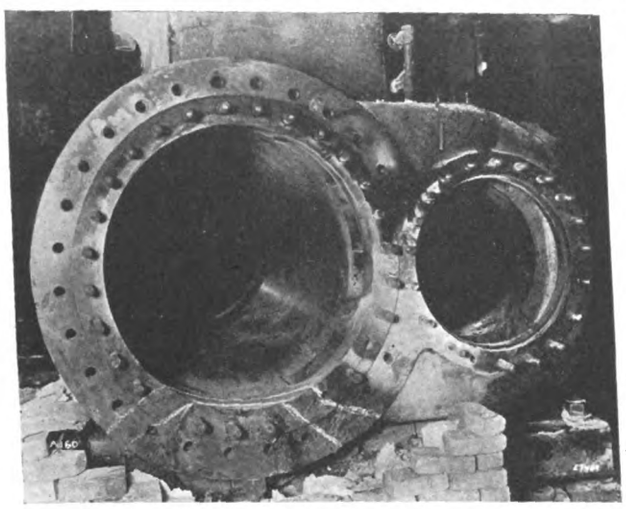

Fig. 5.—Flange Welded on 5-Ton High-Pressure Cylinder. Weld 4½ Feet Long, 3½ to 6 Inches Deep

After the engine cylinders were machined, it was almost impossible to determine where the cracks occurred. The total cost of this repair represents but a small fraction of the replacement cost, but even this saving is insignificant when compared with the disorganization which would have resulted from the laying off of a large body of trained workmen and with the enormous loss that would have been entailed in a stoppage of production.

Oxy-Acetylene Welding at the Morse Dry Dock

THREE hundred burners and welders are employed at the large ship repair yard of the Morse Dry Dock & Repair Company, Brooklyn, N. Y. Rivets, plates, angle irons and channel iron, staybolts and boiler tubes and many other parts of ships are quickly cut with the oxy-acetylene torches at a very low cost.

The welders are reclaiming many broken castings, thereby saving both time and money. Among the more important parts reclaimed are broken pump cylinders of various sizes made of cast iron and steel. The savings made in this way are shown in the following report made by the Morse Dry Dock & Repair Company to the Air Reduction Sales Company, New York:

BROKEN AIR PUMP CYLINDERS

Diameter of cylinder, from 6 to 24 inches.
Weight of cylinder, from 50 to 600 pounds.
Cost of welding, from $2 to $25 (8/4 to 5/4/2).
Saving involved, from $75 to $1,000 (14/11/8 to 208/6/8).

CAST IRON AND STEEL GEAR WHEELS

Diameter of wheels, from 1 to 12 feet.
Weight of wheels, from 25 to 1,000 pounds.
Cost of welding, from $1 to $200 (4/2 to 20/16/8).
Saving involved, from $10 to $4,000 (2/1/8 to 833/6/8).

Cast steel anchor chain winches, known among shipbuilders as "wild cats," become worn and are built up and reclaimed for less than $10 (2/1/8), thus saving $250 (52/1/8).

Brass propeller shafts when worn are quickly built up by this method, saving from $100 to $4,000 (20/16/8 to 833/6/8). These shafts range from 4 inches to 24 inches in diameter and 1½ feet to 30 feet long.

CRACKED STEEL SHELL PLATES RECLAIMED

Size of Plates	Thickness	Saving
3 feet by 27 feet	⅞ inch	$500 (104/ 3/4) each
4 feet by 6 feet	½ inch	75 (15/12/6) each

Cast iron compass stands with broken lugs and bodies, weight 150 pounds, are reclaimed with a saving of $50 (10/8/4) each.

Many other castings are also reclaimed by the oxy-acetylene method.

Declivities of Launching Ways

BY W. JONSEN

THE accompanying curve indicates in a simple form suitable declivities of keel and launching ways for vessels of varying size and similar type, the type dealt with being cargo vessels of ordinary form.

Local conditions, such as the natural slope of the ground, extent of water available in front of the building berth, length of run before entering the water, and amount of rise and fall of tide, are, of course, factors which may influence these declivities; but, assuming average conditions to hold, the curve may be taken to represent sound practice. If the vessel has any considerable distance to run

VESSEL	A	B	C	D	E	F	G	H	J
TYPE	Barge	Dredger	Tug	Passenger	Cargo	Cargo	Cargo	Cargo	Cargo & Pass'r
Principal dimensions	230′x 38′ x 15′	330′ x 53′ x 22′	130′ x 26′x13′	370′x47′x19	230′ x 36′ x 17′	340′ x 44′ x 26′	440′ x 53′ x 39′	480′x 56′ x 36′	500′ x 56′x 36′
Launch displacement in tons	750	2500	240	1600	750	1980	3600	4800	5600
Declivity of keel	9/16	9/16	9/16	9/16	9/16	9/16	½″	½″	½″
Declivity of tangent to standing ways	12/16	21/32	12/16	22/32	11/16	9/16	37/64	9/16	37/64
Camber in length of slide	7″	12″	2″	18″	Nil	7″	7″	12″	15″
Length of slide in feet	180	295	90	310	192	285	360	405	435
Width of slide in inches	22	22	14	22	14	33	33	33	33
Area of slide in square feet	655	1080	210	1135	450	1570	1970	2230	2320
Pressure per square foot on ways in tons	1.15	2.3	1.15	1.4	1.67	1.27	1.83	2.15	2.4
Water on way ends	Nil	Nil	4′ 6″	3′ 6″	1′ 6″	1′ 0″	4′ 0″	4′ 6″	4′ 0″

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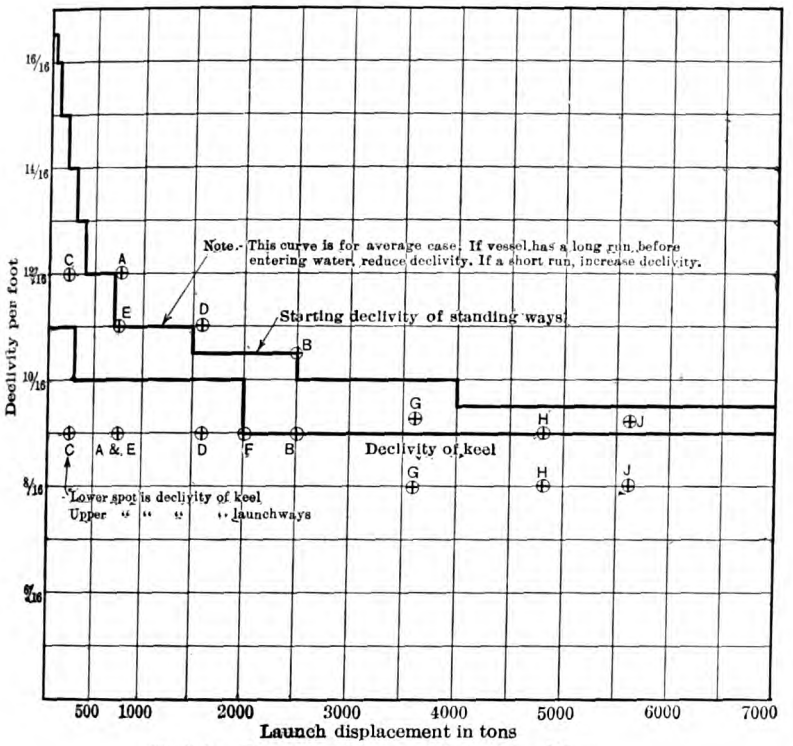

Declivity Curves for Keel and Launching Ways

before entering the water, the declivity indicated by the curve for vessels of over 1,000 tons launching displacement should be reduced by an amount of from 1/32 inch to 1/16 inch per foot, according to local conditions.

The table gives particulars of vessels which have been successfully launched; in these cases the start was frequently slow, and the length of run before entering water gave the vessel sufficient speed safely to clear the launchways. In consequence, it will be noted that the curve indicates declivities generally in excess of the actual cases quoted.

Camber has been stated in the table over the length of the slide, as it will be a simple matter to proportion the camber over any length of standing way. Introduction of appreciable camber calls for judgment and experience, as care must be taken that for a long length of standing way the camber does not result in too small a declivity below the center of the vessel when still at rest, and that too great a poppet pressure does not obtain when the stern lifts. If good judgment is exercised, however, camber may have the effect of considerably shortening the standing ways.

Development of River Docks and Terminals on the Mississippi River

SINCE the Government appropriations were made for the building of modern barges and towboats for use on the Mississippi River, the cities using the service have made rapid progress in the development of terminal facilities. The concrete terminals which are being constructed at St. Louis were described at length in the April issue of MARINE ENGINEERING.

The city of Alton, Ill., one of the first ports to complete its river terminals and docks, has installed an unusual type of freight-handling machinery at that point. Among the apparatus utilized is a Brown portable barge-loading device. This is constructed so that it may be used on steep and sloping banks, can be adjusted for high and low water, and provide for both loading and unloading service. The equipment, which is comparatively inexpensive, is suitable for installation at the smaller ports.

The city of St. Paul is building a double-track trestle on the river front about 800 feet long and constructing a levee about 100 feet wide along the side. The city has installed a Horton & Steinbrenner locomotive crane and a gantry crane. Chutes and hoppers have also been built in the floor of the bridge owned and controlled by the St. Paul Bridge & Terminal Railway Company. This provides for the rapid unloading of iron ore from railway cars to the barges.

Other cities are actively engaged in gathering data and raising money to construct adequate port facilities. The city of Memphis, Tenn., has a committee working out details for a $500,000 (£105,000) terminal project. The city of Shreveport, La., is also actively engaged in planning the construction and equipment of barge terminals. Greenville, Natchez and Louisville, as well as other cities along the Mississippi and Ohio rivers, are working out definite plans for terminal developments. The city of Helena, Ark., has already raised $20,000 (£4,100) as a preliminary fund for the development of docks and terminals at that city, according to the report of L. R. Parmelee, city engineer.

Shipbuilding at the Pensacola Yards

BY JOHN M. SWEENEY*

AT the Pensacola Shipbuilding Company's new yard at Pensacola, Fla., there was launched on March 15 the 9,000-ton cargo ship *Cushnoc*, establishing a record for the side-launching of a vessel on the Atlantic or Gulf coasts. It is quite unusual that first launchings in new yards occur without a hitch of some kind, but the launching of the *Cushnoc* could not have been more successful in the oldest yard and with the best trained force of men accustomed to such work.

The Pensacola Shipbuilding Company has built its yard with the object of doing the work properly and thoroughly. Consequently, the company has in no way been tempted to hurry the launching at the expense of proper testing of the work before launching. This is applied particularly to the tank testing, and the result of this policy is seen in the case of the *Cushnoc*, which went overboard without showing a leak or developing a mishap of any kind.

The Pensacola Shipbuilding Company has been particularly fortunate in securing the supervisory services of David Hunter, in charge of the National Shipyard at Violet, La. To Mr. Hunter's knowledge, care and forethought are particularly due the successful launching of the *Cushnoc*. Mr. Hunter was ably assisted by Bill Michel, of the Emergency Fleet Corporation.

Immediately after the *Cushnoc* had cleared the ways, the keel of the next ship was put on the blocks. The Pensacola Shipbuilding Company operates five ways and has four other ships approaching the launching period, which will follow the *Cushnoc* in close succession.

* President, Pensacola Shipbuilding Company, Pensacola, Fla.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Extra Bench Grinder

The engine room oilers were forever pestering the life out of the shop machinist in using the emery wheel and taking off the wheel to put on a buffing rag. One day one of them asked permission to make up an extra wheel stand, telling the chief he could do so with an old, worn-out motor boat gas engine piston.

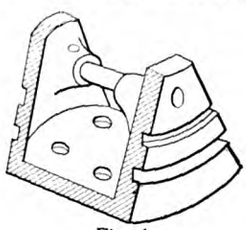

Fig. 1

The sketches show how he rigged up the device. The piston was machined down to the shape shown in Fig 1. The old wrist pin was removed and the holes slightly enlarged by reaming, then twin bronze bushings were fitted and a small steel shaft made for the emery and buffing wheels. A pulley was turned up to fit the space in the center and secured with a blind set screw.

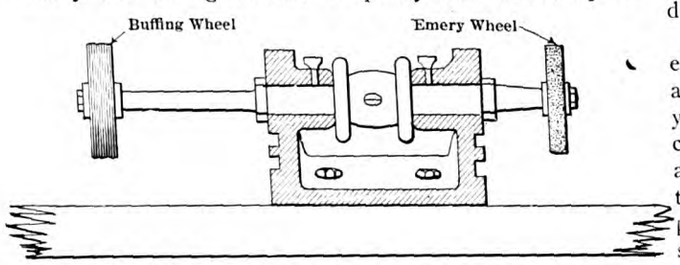

Fig. 2.—Handy Extra Emery and Buffing Wheel Made from Old Motor Boat Engine Piston

Check nuts were used for thrust collars on each end outside the piston. Oil cups were put in on the bosses inside and this completed the idea. The rig was securely fastened to the bench and run at proper speed.

Concord, N. H. C. H. Willey.

Watching the Little Things

That an ounce of prevention is better than a pound of cure is an adage that is no less true than that a stitch in time saves nine. The latter, as well as the former, applies on shipboard equally as well as on "dry" land. Emergencies arise in the operation of vessels—particularly in the engine room—which are liable to develop into serious trouble, if not completely stop the vessel, unless adequately met and overcome before the thing is too late. I know of one instance that happened on the ship where I was chief that would have proved a dire mishap if I had listened to the advice of others, especially my otherwise friendly and capable second assistant engineer.

We had just rounded the Horn on our way from San Francisco to New York. I happened to be in the engine room for some reason or other and, passing the main steam riser, I caught a slight puff, like a pin-prick, against my cheek. Instantly I thought of a leak. I carefully examined the pipe but could locate nothing that gave even the semblance of a crack in the riser. Yet as I sought I again felt the pin-prick against my cheek. I was a bit troubled. We were running under 185 pounds of steam, and a break in the steam line meant, of course, serious consequences. I called to the assistant and put the thing up to him. He felt around the joint—the leak, if leak it was, was in the vicinity of the flanges—and he likewise was convinced that something was wrong. Yet he fairly grinned when I suggested that we cut down the pressure to 150 pounds as soon as possible and set up around the piping some form of reinforcement. But I insisted that this be done.

We got busy. We made a clamp out of flat iron stock, in two pieces, with the proper bolts for staying, and clamped this around the pipe at a point immediately above the topmost flange, which was where the puff of steam was coming from. Then, despite the smiles of my second assistant, I saw that the pressure was lowered in the boilers from 185 pounds to 150 pounds. Under this reduced pressure we came on to New York.

As soon as we could, we took down the main line and examined it for pinholes, which was what my second assistant declared to be the source of the trouble. And do you know what we found? The main steam pipe was cracked from the flange up to a point some seven inches above the flange! It was an almost imperceptible crack, to be sure. Nevertheless, had I not reduced the steam pressure and placed a reinforcement around the pipe, we should undoubtedly have experienced some very annoying times in that engine room in order to bring the ship to port.

"Chief."

A Successful Method for Drawing Keys

There are many and various ways of drawing gib-headed keys, though there is only one real method of getting a strangle hold and utilizing all of the strength of the key section in such a way as to start the key, which is the biggest part of the job, and which must appeal to the mechanic who has never tried it. After shooting, which is not always practical or possible, this is the next best method:

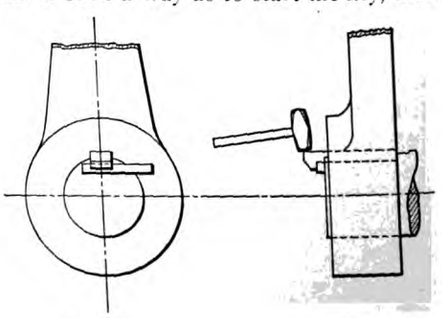

Fig. 1 Fig. 2

A piece of square-section tool steel with the very slight-

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est amount of taper is properly fitted under the gib, which should also be filed to the same taper, so as to make a perfect metal-to-metal fit. This piece is driven in tight enough to feel solid, though not enough to cause bending or fracture.

The amount of care with which this piece of steel is fitted is always worth the amount of time spent on the job; as, should the gib be broken off, it means drilling and tapping for the stud to draw it out. Should this fail, careful drilling must be resorted to in order to get as much section out of the key as possible, thereby loosening it. After the foregoing work is done, the key is marked with a scriber and a good stout blow given it on the opposite side to the fitting piece, and, in almost every instance, on looking at the scriber mark, the key will be found to have started. The fitting piece is again set up as before and the process repeated as often as necessary, using shims to build up until it is loose enough to draw with a pinch bar.

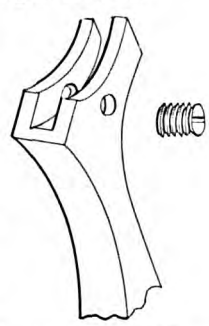
Seattle, Wash. SEAGOING ENGINEER.

Unique Angle Wrench

This wrench is the result of experimenting to see what could be done to make a handy open-end wrench that

could be used at all angles. The need of such a tool is obvious to those who have to carry about a lot of solid wrenches in order to get at nuts in tight corners.

This wrench is made of good steel. It is in two pieces—the wrench jaws and the handle. It can be made to answer for six different angles of solid wrenches, the screw or pin being the means of locking the handle in any position desired. The outside edge of the wrench is a true circle and the handle conforms to this. A series of six holes for the pin is drilled as shown. MECHANIC.



Improvised Angle Wrench

Useful Information

A very good paint for smoke pipes, boiler casings, gas engine mufflers, or anywhere that a heat-resisting paint is needed, can be made as follows: Mix thoroughly three parts of graphite, two parts of black oxide of manganese with nine parts of fuller's earth. Then to this mix a compound of one part glucose, ten parts sodium silicate, and four parts water. Stir until it is all of the right consistency to apply with a brush.

Paint brushes that have been allowed to become hard can be revived for use if treated in either of these ways: First method, soak them a few days in turpentine, then remove and wash with yellow soap and hot water, working the bristles with the fingers, then wash the brushes with gasoline (petrol) and rinse out with kerosene (paraffin). Second method, soak them in hot vinegar.

DRILLING GLASS

By mixing camphor with turpentine, one can use a regular twist drill to put holes in glass. Make a small circular dam of putty to hold the drilling compound; drill steadily and with moderate pressure. When the point of the drill starts through the glass, stop drilling and finish the hole by reaming with a three-corned file which has its edges ground sharp.

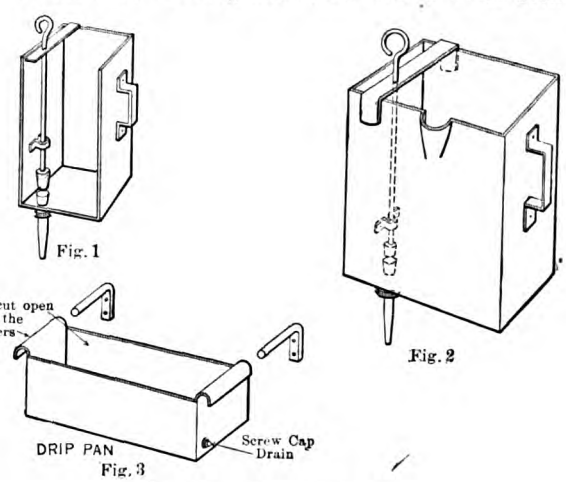
KEEPING PUTTY

Sometimes when a pane of glass has been set there is a handful of putty left over. This will come in handy if preserved. Wrap it in a piece of brown paper, put it in a fruit jar and cover it with water; then screw or clamp on the jar top. This prevents the water evaporating. Putty will keep indefinitely when taken care of in this way.

C. H. W.

Uses for Oil Tins

In spare time a few useful articles can be made from empty five-gallon oil tins. A very handy oil cup filling device that I made is shown in Figs. 1 and 2. It is very simple to construct, as follows: Cut out the bottom of the oil tin and next transfer the handle from the top to the side. Next make a small long-taper funnel that will fit inside the screw-top opening. Solder this in place on the inside of the can. A long rod fitted with a small cork



Special Uses for Oil Tins

stopper on one end and working in brackets soldered to the inside of the can is used as a valve to open or close the funnel opening. A lip is made on one edge of the tin for pouring out the remaining oil after all cups have been filled.

Fig. 2 shows a simple way to make a small drip pan to use under the oil filter or tank; it is made by cutting open one side of an empty tin and bending back a section of this to form the hangers by which it is set on two simple brackets. As the can has a screw cap at the one end, it provides a handy method of draining it out.

ASSISTANT.

Testing Compression

The other day I was visiting a ship tied up to the other side of the same dock at which we were berthed, and for this visit of a few minutes and short distance I was rewarded with a couple of kinks worth remembering.

One of them I have illustrated with a sketch. It is a simple idea, but one that I, and perhaps many others, never thought of. The second engineer was giving the ship's motor launch engine an overhaul, and at the time I arrived he was testing the engine cylinders for compression. For this purpose he had rigged up a small pressure

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gage, using the base of an old spark plug for this purpose. The use of a small pressure gage in this manner accurately indicated the condition of the piston rings and valves of each cylinder tested.

The other kink is shown in Fig. 2—a very powerful

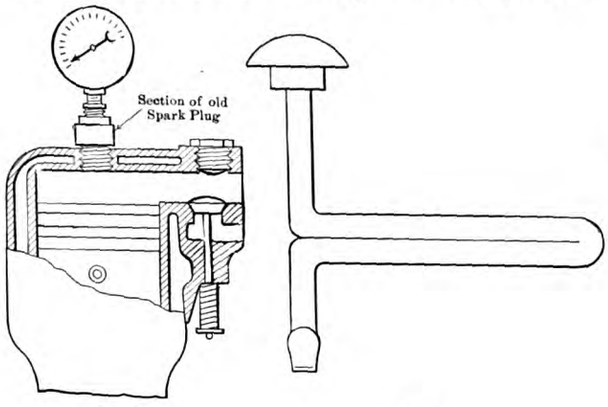
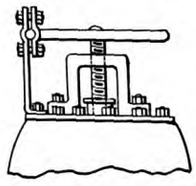


Fig. 1 Fig. 2

type of screw driver that is quickly and easily made from a piece of ⅜-inch round stock. It is for driving in or taking out stiff screws. C. H. W.

An Ingenious Clamp for Preventing the Opening of Sea Injection and Overboard Discharge Valves When Putting a Ship Out of Commission

In order securely to close the sea injection and overboard discharge valves of our ship when putting it out of commission, I have found the clamp described below helpful. As the idea may be useful to other marine engineers, it is submitted for publication.



Arrangement of Clamp

The clamp is made from flat iron or steel 3/16-inch or ¼-inch thick and as long as the distance from the bonnet to the handwheel, with allowance for bending the foot and forming the upper end. The valve should be closed when taking the measurement. One of the studs should be removed and replaced by a longer one, according to the thickness of the metal of the clamp.

After forging the clamp, a short strap is shaped to fit the handwheel. Corresponding holes are drilled at each side of the forged part, fitting the handwheel. A clearance hole is drilled in the foot of the clamp to slip over the stud in the bonnet. The clamp should be fitted so that the short strap comes on the inside of the handwheel. If it is necessary to use the valve again, a few minutes' time is sufficient to unbolt the strap.

In securing the feed and steam stop valves of a boiler when required to work inside, this type of clamp does the job in a first-class manner, as it cannot be accidentally opened, admitting steam or hot water on the workmen in the boiler.

U. S. S. *Iowa*. FRED W. MIERKE.

From January 1 of this year to May 7, a total of 204 steamships with an aggregate of 781,980 gross tons were delivered to the United States Shipping Board by American yards. From January 1, 1918, to December 31, 1918, the output was 527 steamships with an aggregate gross tonnage of 1,991,587.

NEW BOOKS

BUREAU VERITAS, REPERTOIRE-GENERAL (General List of Merchant Shipping of All Nations). Volume I, Steamers and Motor Vessels, 1918-1919. Size, 10½ by 11 inches. Pages, 1,182. Volume II, Sailing Vessels, 1918-1919. Size, 10½ by 11 inches. Pages, 795. New York, 1919: Bureau Veritas. Price (two volumes complete), $25.00.

The Repertoire-General, issued yearly since 1870 by the Administration of the Bureau Veritas, is printed in two volumes, one dealing with steamers and the other with sailing vessels. The first volume contains an alphabetical list of all sea-going merchant steamers and motor vessels of 100 gross tons and upwards of all countries of the world excepting barges, ferry boats, dredges, yachts, etc., and vessels for inland navigation. Vessels of the Great Lakes which are partially employed for ocean service are included in this list. The volume also contains the following lists: Petroleum-carrying steamers, cable ships, changes of name, compound names, steamers of 10,000 gross tons and upwards, signal letters of all nations, builders of iron or steel, wooden and ferro-concrete ships, owners of steamers and motor vessels in the order of nationality. During recent years lists of vessels fitted with refrigerating apparatus and a list of salvage companies have been added.

The second volume contains an alphabetical list of all sea-going merchant sailing vessels of 50 gross tons and upwards of all countries of the world, followed by a separate list of sailing vessels fitted with auxiliary engines or motors. This volume likewise contains a list of changes of name, a list of vessels having compound names, the signal letters of all nations and a list of owners of sailing ships.

Each volume contains also a table showing general statistics arranged according to nationality of the vessels therein and a table showing statistics of the vessels built, bought or sold in the different countries during the preceding year.

THE DELAMATER IRON WORKS: THE CRADLE OF THE MODERN NAVY. By H. F. J. Porter, M. E. Size, 8¼ inches by 10¾ inches. Pages, 45. Illustrations, 23. New York, 1919: H. F. J. Porter, M. E., 200 Fifth avenue.

At the meeting of the Society of Naval Architects and Marine Engineers, held in Philadelphia on November 14, 1918, the first paper, entitled "The Delamater Iron Works: The Cradle of the Modern Navy," was presented by H. F. J. Porter, M. E., who spent four years at this historical plant after leaving college in 1878. Mr. Porter has consented to issue a limited edition of the paper in the form outlined above.

The paper recounts the history of the Delamater Iron Works from the time it started as the Phœnix Foundry on West street between Vestry and Eighth streets, New York, under James Cunningham in 1838. The plant was taken over by Peter Hogg and Cornelius H. Delamater in 1843. It was moved to the foot of West 38th street in 1850 and was finally closed in 1890. The paper describes the developments which took place at the plant during fifty years under the direction of Mr. Delamater and Captain John Ericsson.

MARINE GAS ENGINES: THEIR CONSTRUCTION AND MANAGEMENT. Second edition. Carl H. Clark, S. B. Size, 5 inches by 7⅜ inches. Pages, 136. Illustrations, 102. New York, 1919: D. Van Nostrand Company. Price, $2.

This book describes briefly the construction and principles of operation of the standard types of marine gas engines, with a special chapter on oil and Diesel engines.

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Amount of Pressure

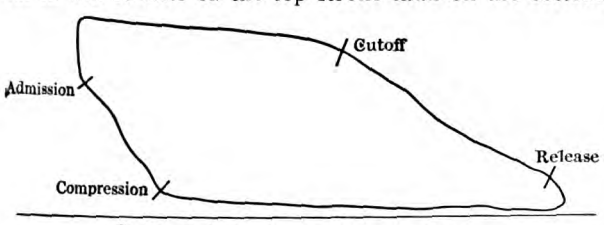
Q. (1006).—What is meant by the pressure on condenser will be 70 atmospheres when machine is fully charged? I do not know what is meant by so many atmospheres. Please explain.

A. (1006).—The barometer under standard conditions will be 30.9 inches, which is equivalent to 14.7 pounds per square inch. Consequently, if the pressure of one atmosphere is 14.7 pounds per square inch, then 70 atmospheres will represent 70 × 14.7, or 1,029 pounds per square inch.

Point of Cut-Off

Q. (1007).—How do you know the point of cut-off on an indicator diagram? What is a common value for the cut-off of a marine engine?

A. (1007).—The point of cut-off on the indicator diagram is often hard to locate, and especially so with many vertical marine engines where the revolutions are fairly high, the valves slow-acting and of small travel. The point of cut-off is usually taken where the outline of diagram changes from convex to concave. The diagram indicates the points at which the various events begin. Due to the angularity of the connecting rod, the point of cut-off will be later on the top stroke than on the bottom.



Position of Events on Indicator Card

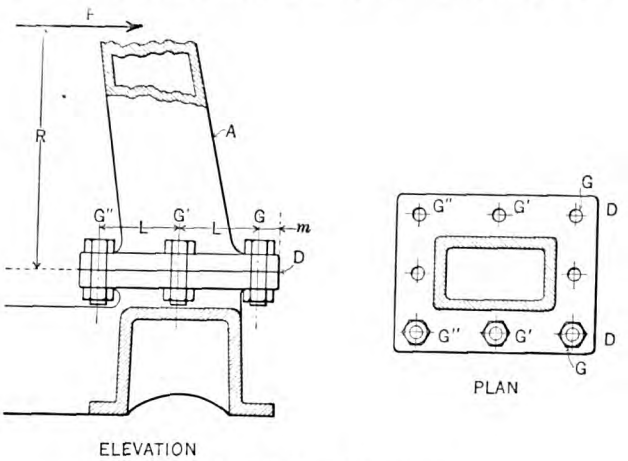
Marine engine practice employs a cut-off at from 50 percent to 80 percent of the stroke, the smaller value being used where economy is all-important, as in cargo vessels (although many merchant ships have a 70-percent cut-off), and the larger value where space and weight must be saved, as in naval practice.

Stress in Column Bolts

Q. (1010).—Under the force F which causes a moment about the corner D, what would be the tensile stress in each of the bolts G, if the distance between them and to the point D were known? A is the guide column of the engine attached to the bedplate by column bolts G. The force F is that exerted by the connecting rod.

A. (1010).—Your question does not mention the fact that we need to know the distance R between the line of action of force F and the column seat. A problem similar to this often arises in the design of riveted joints. It is customary, and it makes the work simpler, to take moments about G, the outer row of bolts, rather than D. Theoretically, however, we should take D as moment axis. Below we shall indicate both methods.

We may consider that the tension in each bolt is proportional to the distance from the moment axis D in the first instance. Then if P represents the tension in each of the bolts marked G'', and since the moment of F about



Sketch of Column Connections

D must equal the sum of the bolt moments about the same, we shall have, taking moments about D,

$$FR = 3P\ (2L + m) + \frac{2P\ (L + m)^2}{2L + m} + \frac{3P\ (m)^2}{2L + m}; \quad (1)$$

or, similarly, taking moment about the outer line of bolts,

$$FR = 3P\ (2L) + \frac{2P\ (L)^2}{2L}. \quad (2)$$

NOTE.—In equation (1) the second term of the right-hand member is obtained when we remember that $\frac{P\ (L + m)}{2L + m}$ represents the pull of one bolt G' in row $G'G'$; its moment about DD will, of course, be $\frac{P\ (L + m)^2}{2L + m}$.

The second equation in this case will give a value of P about 10 percent higher than the first. In this particular problem it should be realized that all large engines will have a column on the other side of the cylinder, which would be capable of taking tension and thus reduce the stress in the column foot. Furthermore, we have not considered the tensile stress in bolts due to steam pressure and acceleration of reciprocating parts, or the shearing stress, all of which should be taken into account. The above method is of more value in design work when forces are better known.

Make-Up Feed Water

Q. (1009).—Although I have looked over many marine texts on engines, I have not found any reference as to how and where the make-up feed is fed into the boiler feed water while the main engines are in operation.

STUDENT.

A. (1009).—A common plan is to run a small pipe from the steam side of the condenser to the feed water tank in the double bottom. The vacuum is sufficient to draw the water into the condenser, and from thence into the feed line.

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Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

DIRECTORS APPROVE SALE OF BRITISH SHIPS OF THE INTERNATIONAL MERCANTILE MARINE

80 Ships Totaling 763,837 Gross Tons—Olympic and Others Included in Deal

On May 20 the board of directors of the International Mercantile Marine Company, 9 Broadway, New York, approved the sale of vessels and assets of the British companies subsidiary to the company, at a price of approximately $130,000,000 (£27,000,000). This action is regarded as closing the biggest deal in American shipping history, since the approval of the stockholders at a special meeting to be held June 16, it is believed, will naturally follow. The release of this huge sum for the operation of strictly American shipping opens up vast possibilities for the future of the American merchant marine.

The cash and assets of the British companies, which include the Oceanic Steam Navigation Company, Ltd. (The White Star Line), which operates 21 vessels totaling 334,307 gross tons, including the *Olympic*, *Adriatic* and other large passenger vessels, The Atlantic Transport Company, Ltd., Frederick Leyland Company, Ltd., International Navigation Company, Ltd., British & North Atlantic Steam Navigation, Ltd., and Shaw, Savil & Albion Company, Ltd., total $60,000,000, including securities in other concerns, war bonds, etc. The amount, therefore, to be paid for the ships is only $70,000,000, or less than $100 per ton.

SHIPS IN POOR CONDITION

Although this rate seems low when compared with present prices, it should be taken into account that all these vessels have received unusually hard usage during the war, have not been kept in repair, and hence could not be considered in first-class condition. To this should be added the fact that 32 of the vessels were built before the present century, and 23 only have been constructed since 1910. The *Olympic*, of 46,359 gross tons, the 24,541-ton *Adriatic*, the 24,547-ton *Belgic* and the 23,876-ton *Baltic*, are the types of vessels which the American merchant marine will have to replace if the same trade routes are to be developed. On the other hand many of the vessels range from 3,013 gross tons up, and can be easily supplied by American shipyard facilities.

Stripped of the British tonnage the International Mercantile Marine will hold only 11 vessels of 130,641 gross tons. Among these are included the 13,639-ton *Manchuria*, the 20,718-ton *Minnesota*, and the 13,639-ton *Mongolia* of the Atlantic Transport Line, and the *Finland*, *Kroonland*, *Philadelphia*, *St. Louis* and *St. Paul* of the American line.

CONTRACT LET FOR $3,000,000 REPAIR SHIP

Puget Sound Yard Will Build Modern Type Repair Vessel

Word has been received from Capt. R. Stocker, U. S. N., head of the designing department of the Bureau of Construction and Repair, Navy Department, of the letting of the contract to the Puget Sound Navy Yard, Bremerton, Wash., for the building of repair ship No. 1 at an estimated cost of $3,000,000.

The vessel will be capable of taking care of all the ordinary repairs of vessels of the fleet, including battleships and battle cruisers. The repair plant which will be installed on board consists of a machine shop, brass and iron foundry, boiler and blacksmith shop, coppersmith shop, pipe and sheet metal shop, pattern and carpenter shop, electrical shop, drafting room, optical shop and gyro testing room.

The repair ship, which is 484 feet long overall, with a beam of 70 feet and a draft of 19 feet, displacing about 10,000 tons, will carry a battery of four 5-inch guns and two 3-inch anti-aircraft guns. The ship will be propelled by steam turbines operating through reduction gearing. It is designed for a speed of 16 knots, and will be equipped with a high-power radio outfit.

Canadian Yard Receives Contract for Three 6,500-Ton Vessels

The National Shipbuilding Company, 42 Broadway, New York, has a contract to build three 6,500-ton steamships for French owners. It is understood that the ships will be built in this company's yard at Three Rivers, Canada.

Newburgh Shipyards Will Build Freight Steamers

The Newburgh Shipyards, Inc., Newburgh, N. Y., is understood to have received a contract to build a freight steamer for the Union Sulphur Company, 17 Battery Place, New York.

MERCHANT MARINE CONFERENCE FAVORS PRIVATE CONTROL OF SHIPPING

Franklin Urges Definite, Permanent Plan to Reassure Ship Operators

At the conference which was held in Washington on May 21-23 between Chairman Hurley of the United States Shipping Board and men representing shipping, commercial and agricultural interests throughout the country, the development of the operation of the American merchant marine by private initiative and capital was recommended in almost every case.

John L. Hamilton, of the American Bankers' Association; Welding Ring, of the New York Chamber of Commerce; N. M. Leach, of the Mississippi Valley Association, and E. P. Thomas, of the Foreign Trade Council, declared against government ownership and operation. Almost the only dissenting vote was expressed by B. F. Marsh, of the Farmers' National Council, who declared that ships "constructed at the government expense should remain the property of the people of the country."

In discussing the question of ship operation, P. A. S. Franklin, president of the International Mercantile, said:

> It is not a question of only manufacturing ships, it is a question of building up individual corporations, banking facilities, sales departments in foreign countries, and other things necessary to enable the traffic to be handled properly. I think it is exceedingly important, and we have given this matter a great deal of consideration, and feel that the steel steamers should be sold to private corporations and private individuals and should be operated absolutely as private property and not by the government in any way, shape or form.
>
> We also feel very strongly that a very comprehensive policy should be adopted by the Shipping Board and by the government for the prospective buyer of these steamers, so that they may know what the future situation is going to be, and not feel that two years from now we are going to have a different policy, and in that time having government-owned ships competing with the privately owned ships. Without such policy it would be impossible to get people to put their money in the enterprise. They feel that if they would wait two years they will have a better opportunity than to-day.

The necessity for establishing regular trade lines was emphasized by J. H. Rosseter, director of the Division of Operations, who said:

> If we should make the mistake of a promiscuous use of this fleet under any random sale or charter and fail to conserve to the nation the present opportunity of building up regular lines, I am afraid that all of our efforts will have gone for naught. Without regularity, without some direction or control, without some control of needless competition, between ourselves and the fierce competition that is coming to us, we are going to fail.

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EXTENSIVE SHIP REPAIR FACILITIES BEING DEVELOPED

Twelve New Drydocks Will Be Constructed

Evidence of the increase in American marine operation is indicated by the extensive ship repair facilities which are being developed at the Atlantic and Pacific coasts and along the Gulf. As may be noted in the marine construction section, this month's reports give a concrete idea of this expansion. Drydocks are being or will be constructed at Mobile, New Orleans, Galveston and St. John, New Brunswick. A 4,000-ton marine railway is included in the plans for the $5,000,000 naval base at Cuba and Charleston, S. C., is to have a $3,500,000 drydock.

The shipbuilding companies are not behind in the movement. The Los Angeles Shipbuilding & Dry Dock Company, the Ames Shipbuilding & Dry Dock Company, the Carl Hartman Company, the St. Helens Shipbuilding Company, the Anderson Shipbuilding Company, and the Lake Union Dry Dock & Machine Works plan to build drydock facilities. The Government Island Concrete Shipbuilding plant at San Francisco may become a huge shipbuilding repair plant. In addition we find smaller marine railways being built at the Hamme Marine Railway and the government repair plant at La Playa, Cal. At a rough estimate these new projects would provide at least 85,500 tons additional ship repair capacity.

ST. LOUIS BIDS FOR TWENTY 8,000-TON VESSELS

Will Be Operated Out of New Orleans to South America and the Orient

Business interests of St. Louis, Mo., represented by the Chamber of Commerce, Jackson Johnson, president, have announced that they are contemplating the purchase of twenty 8,000-ton deadweight vessels from the Shipping Board to handle the river traffic of St. Louis shipped from the port of New Orleans.

From Memphis it was recently announced that Joseph Newburger, chairman of that city's Chamber of Commerce, was preparing plans for the organization of a $1,000,000 corporation of purely Memphis capital, to purchase and operate ships from New Orleans.

Bids on Four Steel Towboats

The United States Engineer Office, 428 Custom House street, St. Louis, Mo., will receive proposals until June 13 for the construction of four steel hull stern-wheel towboats for use on the Upper Mississippi river. Further information will be furnished on application.

PRESIDENT REMOVES BAN ALLOWING SHIPYARDS TO ACCEPT CONTRACTS FOR FOREIGN FLAGS

Chairman Hurley May Reconsider Plan to Cancel Contracts for Two Million Tons of Ships

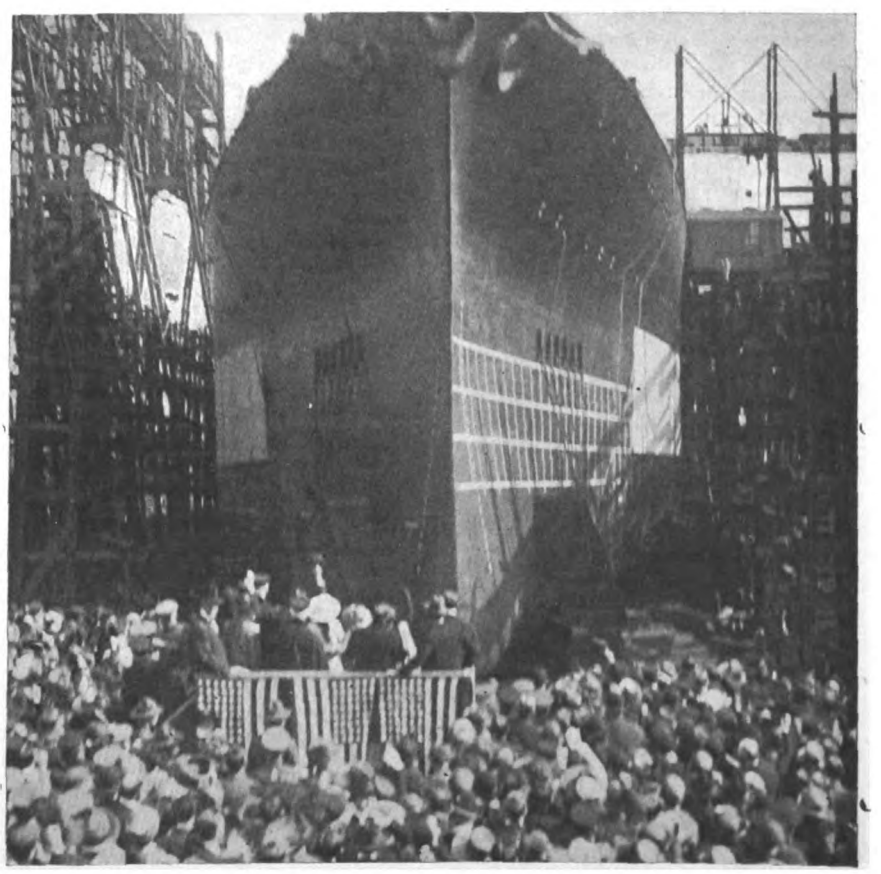
On April 30 Charles Piez made a strong protest, at a dinner given in his honor by the Atlantic Coast Shipbuilders' Association, against the cancellation of contracts for two million tons of shipping, as announced by the Shipping Board and against the ruling which prohibited the shipyards from accepting foreign contracts. Subsequently the leading shipbuilders of the country cabled President Wilson asking him to take immediate action along these lines to improve the shipbuilding situation. Following these moves it was announced from the White House on May 14 that "upon suggestion of Chairman Hurley, of the United States Shipping Board, the President has taken action which will permit American shipyards to accept foreign contracts, so far as that can be done without interfering with the building programme for American register."

ABOUT 3,000,000 GROSS TONS MAY BE BUILT

Possibilities for the placement of foreign contracts with American yards, the chairman said, could be estimated at from 2,500,000 to 3,000,000 gross tons. This is the amount of foreign contracts in sight at present, the chairman said, which might be obtained by the yards of the country if the necessary attractive prices and other inducements could be offered.

There is a strong possibility, the chairman said, that Norway might place with American yards contracts totaling 1,000,000 tons. France, although having already placed contracts totaling 500,000 tons with British yards, contemplates the placement of an additional 500,000 tons, which may be obtained. Italy also is inquiring for the most satisfactory ship offers for the award of steel ship contracts totaling 500,000 tons.

Chairman Hurley declared that although it is expected that a large number of substantial ship contracts probably will be awarded as a result of the President's action in the removing of the foreign ship contract ban, it is not believed that there will be any rush by foreign contractors to place contracts in the United States. Satisfactory prices must be quoted to attract the foreign contracts, he said. The most attractive price offered thus far, the chairman said, was $170 a ton, in the recent sale of shipping to foreign buyers.



(Photograph by Press Illustrating Service)

Battleship *Tennessee*, Launched from the New York Navy Yard on April 30

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As an inducement to prospective foreign ship purchasers, Chairman Hurley added, the Shipping Board in all probability will modify its regulations prohibiting the transfer of American-built tonnage to foreign flags to permit the transfer of the foreign-contract tonnage to whatever flag desired. The Shipping Board in a large measure will be governed by the similar regulation of the British Ministry of Shipping.

LARGE SHIPBUILDING PLANTS ALREADY HOLD CONTRACTS WHICH WILL KEEP THEM BUSY THROUGH 1919

Interviews with officials of several large shipbuilding companies have shown that some of these yards will not be open to take on new contracts through 1919. The New York Shipbuilding Corporation, for example, holds contracts which will keep it occupied through this period. The shipyard of the William Cramp & Sons Ship & Engine Building Company, which also holds extensive Government contracts, it is reported, could not possibly enter the field in 1919. Henry Carse, president of the Submarine Boat Corporation, stated that the efforts of that company would be concentrated upon producing tonnage for the Emergency Fleet Corporation.

Robert Niles, of the Foundation Company, 233 Broadway, New York, expressed disappointment that the yards had not been permitted to accept contracts immediately after the signing of the armistice, when he considered conditions more favorable than at present.

GOVERNMENT SHIPBUILDING PROGRAMME NECESSARY

Harrison Robinson, secretary of the California Shipbuilders' Committee, made the following statement regarding the new ruling: "The Government has forced the shipyards to decline contracts for 3,000,000 tons since the signing of the armistice and foreign business has been educated to go elsewhere. Again, it would be six months before we could start business on such contracts, and we are faced by an emergency which we must meet at once, the presentation of the domestic programme."

HURLEY EXPLAINS CANCELLATIONS

In explanation of the announcement that the Shipping Board expected to cancel 2,000,000 tons of ship contracts, Chairman Hurley issued a statement showing that these cancellations seemed advisable in order that the American merchant marine may be so balanced that it can operate in world commerce profitably. He advocated the building of larger vessels and passenger liners.

Before leaving for Chicago Charles Piez, former director-general of the Emergency Fleet Corporation, gave it out that Chairman Hurley had abandoned his policy of scuttling large contracts, as announced previously.

Commander J. L. Ackerson, assistant to Chairman Hurley, has announced that an appropriation of over $600,000,000 by the end of June will be needed to continue the shipbuilding programme.

Record in Refitting Transport Vessels

The American Standard Ship Fittings Corporation, 115 Broadway, New York city, which entered the field of refitting vessels for army transport service during the last of January, 1919, has completed the refitting of the *Minnesotan, Soshone, General Gorgas* and the *South Bend,* at a cost of approximately $750,000. This work has been carried out in less than three months' time.

The work on the *South Bend,* which was under contract to be completed within eighteen days, involved the transformation of housing quarters, as well as additional work on boilers and engines amounting to approximately $200,000.

Twelve Piers for Staten Island

The sinking fund committee of the New York Board of Estimate has voted to endorse the resolution authorizing the city to acquire 8,900 linear feet of water front at Staten Island. An appropriation of $3,000,000 was made as a preliminary instalment.

The water front, which runs from the foot of Marietta street, Tompkinsville, to the Pouch Terminal at the foot of Edgewater street, Rosebank, will be used for the terminals, warehouses and the installation of other terminal facilities. It is planned to build twelve piers on this site; each pier will be 125 feet wide and 1,000 feet long, with a water space of 300 feet between piers. The depth of water at the piers will be dredged to 44 feet. The work will cost at least $10,000,000.

Schwab Will Spend Millions on Sparrow's Point Plant

Charles M. Schwab, of the Bethlehem Steel Corporation, Bethlehem, Pa., announced in Baltimore on May 20 that he would spend between $25,000,000 and $40,000,000 in improvements at the Sparrow's Point plant. This will be in addition to the $50,000,000 improvements now being completed. The adding of ten ships to the present ore fleet of the corporation is among the improvements for which the appropriation will be made.

$5,000,000 New Navy Yard for Cuban Government

The Cuban Government is to build a new $5,000,000 navy yard at Triscornia, Havana harbor. All plans for this modern storage and repair base are in the hands of Monks & Johnson, architects and engineers, 78 Devonshire street, Boston, who planned and supervised the construction of the Victory plant at Squantum, Mass., and other large plants for the United States Government. The new Cuban navy yard is to include three marine railways, storehouses, machine shop, foundry, forge shop and barracks. The shops will have full crane service and up-to-date equipment. Details and engineering information on this project are not yet available.

SHIPYARDS TO CONTRACT WITH THE SHIPPING BOARD AT FLAT PRICE

Elimination of Cost-Plus Basis May Work a Hardship Upon Companies With Insufficient Financial Backing.

Revision of the Shipping Board building programme to a peace basis has been placed before representatives of the Atlantic Gulf and Lake yards by the Shipping Board in recent conferences. The b ilders were asked if they were prepared to accept flat prices in lieu of the cost-plus basis in use during the war. Where keels have not yet been laid the Board expects generous co-operation from the yards to lower prices to a normal level. It is reported that nearly $700,000,000 additional appropriation will be needed to carry out contracts which the Board has already been authorized to make.

Plan $60,000,000 Terminal Project Off New Jersey Coast

The Lord Construction Company, New York, has made a proposition to the New Jersey State Board of Commerce and Navigation, of which J. Spencer Smith is chairman, for the construction of a huge terminal on Robbins' Reef, in New York harbor.

By means of a fill it would be possible to reclaim 370 acres of land one mile off the Bayonne shore. The construction work, which would be carried on by a new concern to be known as the Jersey Dock and Terminal Company, would include the building of two huge railway trestles connecting the island to the mainland. The island itself would be equipped with piers and warehouses of the latest design.

$5,000,000 for Savannah Harbor

A project is on foot to spend $5,000,000 for the further development of Savannah harbor. The plan includes the building of two piers with adjacent warehouses. If the present plans are accepted by the City Council these piers will be built 1,500 feet in length of fireproof, durable construction.

Plan to Improve Milwaukee Harbor

With the retaining of H. McL. Harding as consulting engineer and supervisor in charge of the construction of the proposed municipal docks and piers at Milwaukee, Wis., actual plans are being laid for the harbor development.

As outlined by Mr. McL. Harding, the first improvement will be the building of a concrete capped retaining wall. The construction will be carried on in sections of, say, 650 feet at a time. Tracks for gantry cranes, a warehouse and railroad tracks on the other side of the warehouse will be built for each unit.

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Atlas Steam Soot Blower

Albert T. Otto & Sons, of 101 Park avenue, New York, have taken the American license for the British "improved diamond steam flue blower (front end type) for Scotch boilers, and are manufacturing this apparatus under the name of the Atlas steam soot blower.

The operation, which is extremely simple, consuming from one and one-half to two minutes, consists of opening the outside steam valve, turning the handle of the blower to the right until checked by stop, and then reverse. As the rotating double nozzle is advanced and returned through the combustion chamber, two jets of dry steam are forced against the tube bank and through the tubes in the natural direction of the draft of the boiler. There is no encumbrance whatever on the smokebox door, as the operating handle is quickly detachable and the door readily opened at any time.

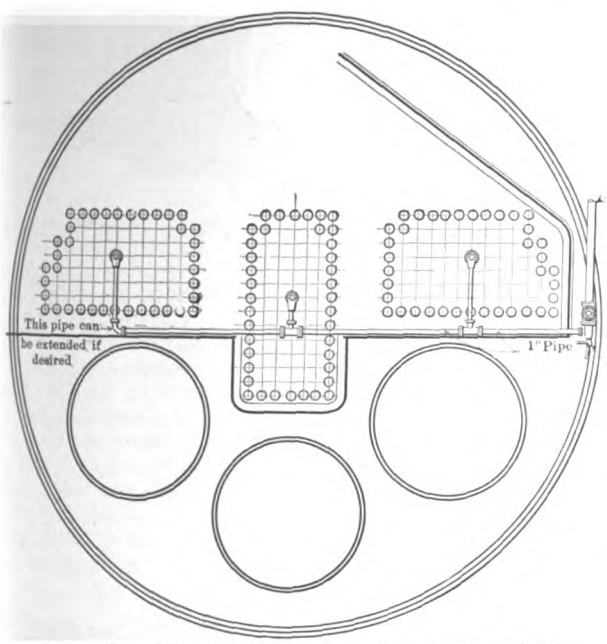
The illustration shows an Atlas installation on a three-furnace boiler. As may be noted, there is one main outside steam valve. Each blower is fitted with an interior valve, which opens and closes automatically by the motion of the handle.

When not in use the blower is telescoped into the tube, which is sealed, out of contact with extreme heat. The use is so short and the results so instantaneous that there is no loss of pressure. The rear plates are cleaned as thoroughly as the tubes, and the blower can be used as often as wished. Hand cleaning is therefore done away with.

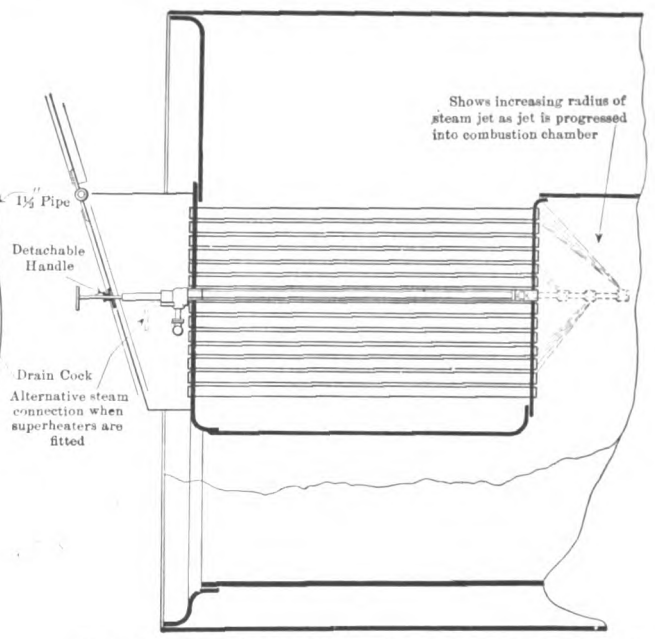
The manufacturers claim that the blower is good for the life of the boiler, and that there has never been a call for a spare part. One of its advantages is its ease of installation—it is just an ordinary job of steam connecting and can be done under pressure. It is practically fool proof; is never in the way and always ready for use.

After exhaustive tests the British Admiralty has adopted this blower to the exclusion of all other makes, and it is used by practically every British steamship line and shipbuilder. The Cunard Line has ordered in the past month over 450 additional blowers. Official tests have shown a saving of 10 percent and over in coal and an increase in the speed of the vessel.

The following extract of a letter from Mr. Charles F. Lumb, head of the English concern, is of interest in connection with the use of superheaters on marine boilers, as illustrating the *necessity of a blower with superheaters:*



Showing Front View of Installation on Three Nests of Tubes. One Steam Valve Controls All Blowers in Box. Each Blower Has Interior Valve Operated Automatically by the Motion of the Handle


Shows increasing radius of steam jet as jet is progressed into combustion chamber
1½" Pipe
Detachable Handle
Drain Cock
Alternative steam connection when superheaters are fitted

By Turning Handle the Rotating Double Jet of Dry Steam Is Advanced Into Combustion Chamber, Thoroughly Cleaning Every Tube Beginning with the Center, and Repeating as It Is Returned to Its Housing.

"One trawler, belonging to Mr. Bascomb, of Grimsby, was equipped with the ——— superheater without the blower. She had gone about thirty miles up the coast when she had to put into port, and the captain telegraphed through that she was unable to make steam. They had to remove the heater, and after the completion of the voyage she was brought back to Grimsby. The superheater was again installed, together with our blowers, and the vessel then succeeded, according to the owner, in reducing her coal consumption by 20 percent.

"Of course, we do not claim the benefit of this altogether to the blower—there is no doubt that the superheater had an important part—but they were useless until the elements were kept clean."

Steam Engines for Auxiliary Schooners

The following information, received from the Talbot Engineering Corporation, 66 Broadway, New York city, emphasizes the possibility of the use of steam engines where weight and space are important factors.

On auxiliary schooners and self-propelled barges it has usually been found unadvisable to use steam engines on account of their bulk. The Talbot boiler, which overcomes this objection, is suited to any grade of fuel from kerosene (paraffin) to thick Mexican oil. The latest Talbot boiler is also fitted for using coal and other solid fuels. The company reports that the same quantity of these cheap grades of fuel is used in the Talbot boiler as would be required to operate ordinary gas engines by the use of gasoline (petrol).

Tests on the steamers where Talbot boilers are installed show a fuel consumption of between one-half and three-quarters of a pound of crude oil per shaft-horsepower. The cost of operation of a Talbot power plant, the company reports, is about 10 to 20 percent of the cost of operation of an ordinary gas engine, and is cheaper than the operation of crude oil engines on account of the inexpensive fuel which can be used. Even in the smaller units, the thermal efficiency is higher than that obtained in large electric power plants, due to the high-pressure superheated steam used. The Talbot Engineering Corporation claims that the Talbot boiler is unusually safe in operation because there are no large steam spaces.

Quick-Acting Ship Winch

The quick-acting ship winch, manufactured by the American Clay Machinery Company, Bucyrus, Ohio, is of the single-drum, single-geared and double-cylinder type, with cylinders 9 inches in diameter by 9-inch stroke. The steam valves are of the piston type. The cylin-

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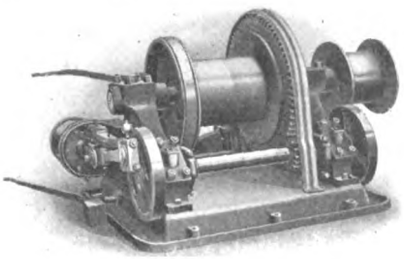
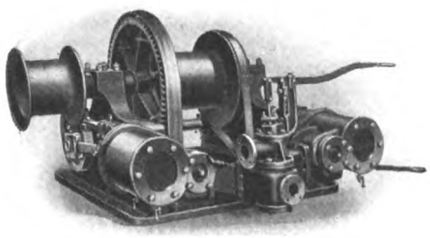
der and steam chest are bored simultaneously to insure accurate alinement. The winch is controlled by a piston reverse valve operated by a hand lever, so conveniently located that it is possible



Front View

for one man to handle two machines at the same time. The valve is provided with a removable bronze liner to prevent sticking.

The gearing is machine molded, ratio of five to one. The drum is 16 inches in diameter, 20 inches long between flanges, and is bolted to a finished surface on the side of the gear, which is keyed to the



Rear View

shaft. The drum is also provided with a friction band brake, lined with Erbestos, thereby, it is claimed, securing perfect control by a slight pressure on the foot lever. The gears are effectively guarded.

The winch head is 14 inches in diameter by 15 inches long, with flanges 21 inches in diameter. The side frames have extra long bearings and are securely bolted to the base plate.

Stationary Electric Riveter

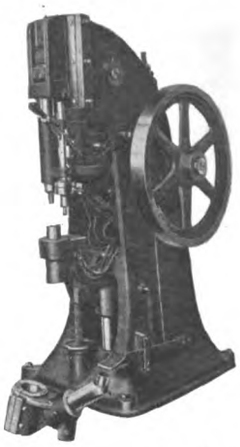
The Thomson electric riveting machines, which are being placed on the market by the Thomson Electric Welding Company, Lynn, Mass., embrace two distinct units within the frame of the machine, one an electrical unit for heating the rivet after it has been set into place, the other a mechanical unit for heading. These two units operate entirely independently of each other, and are so arranged that they require a minimum amount of space in the frame of the machine. One operator can handle both operations.

Most machines arranged for heating rivets by means of an attached transformer have proved unsuccessful because of the dies used. In cases where steel was employed in order to supply material of sufficient strength to stand up under the pressure of heading the rivet, these dies were found to be poor conductors of electricity. On the other hand, if copper was used, the dies were found to lack strength. To overcome these difficulties the Thomson electric riveters are constructed with two separate upper dies mounted on a sliding head, so as first to utilize a copper electrode in contact with the rivet shank, in order to produce the proper heating effect, and then to employ a steel die to head the rivet by one stroke of the power-driven press.

The actual heating time on a ¾-inch rivet through two ½-inch plates is recorded as 15 seconds. On a production basis, therefore, it is possible to drive 125 rivets of this size in an hour on small structural steel assembly parts. Based on average power rates the electricity used costs only about 5 cents. With this machine electrical energy and mechanical power are utilized only during actual heating and heading. In the stationary riveter illustrated, the upper copper die and the lower steel die holder are both water-cooled. All play that may develop in the vertical slide of the press action may be taken up by a gib with three adjustment screws.

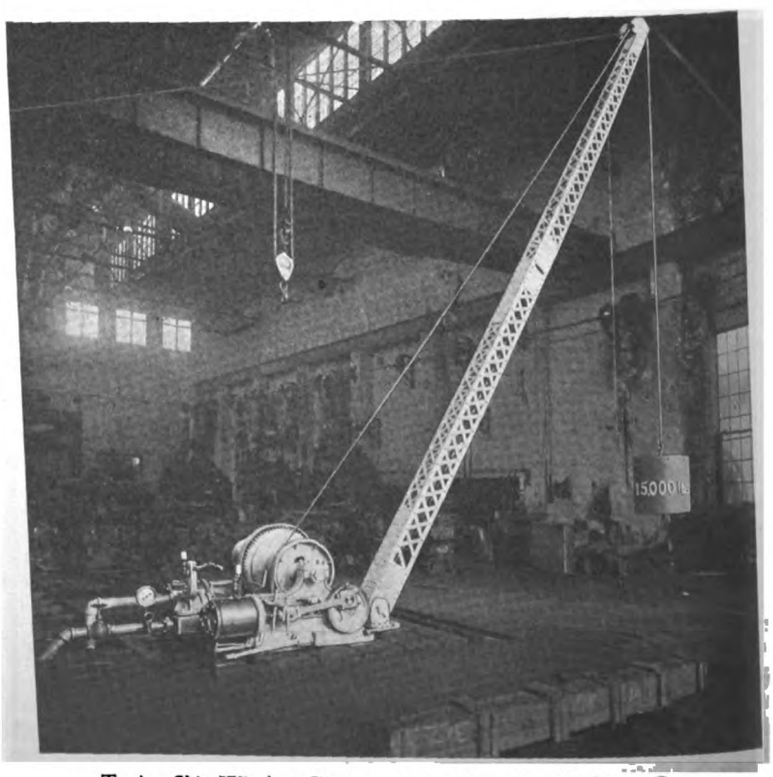
In operation the rivet is heated with the copper die until the shank has reached nearly white heat. The operator then swings the sliding head to the right, bringing the steel heading die in line directly over the hot rivet. By the depression of the foot treadle, the heading die makes one full down-stroke, completely heading the rivet. To provide against premature depression of the foot treadle, the sliding head is provided with a tongue protruding from the rear of its vertical fulcrum, which, through a bell-crank connected to the clutch-operating mechanism, blocks the downward stroke of the foot treadle unless the steel heading die is squarely over the center of the lower die.

An enclosed regulator switch is provided to regulate the secondary voltage



Type C Stationary Electric Riveter

to suit the various sizes of rivets being handled by the machine. The transformer of this machine can be wound for 220, 440 or 550 volts, 50-to 60-cycle, single-phase alternating current only. Special windings are furnished for an odd voltage, or the transformer can be built to operate on frequencies from 25 to 40 cycles, if desired. To meet the demand for a horn with more clearance, a special lower horn, shown detached at the foot of the machine, can be supplied.



Testing Ship Winch at Factory of American Clay Machinery Company

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Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects—Launchings—Government Contracts

NEWS OF SHIP CONTRACTS

The Clinton Shipbuilding & Repair Company, Philadelphia, Pa., is building a wooden tug for E. J. Barton, 1 Broadway, New York city.

Downey Shipbuilding Corporation, 5 Nassau street, New York city, has received a contract to build a steel cargo carrier for a private American account.

Haviside, Withers & Davis, San Francisco, Cal., have received a contract for rigging 20 vessels for the Foundation Company. Ships are being constructed for the French Government at Vancouver, B. C.

Hodges Boiler Works Company, Mobile, Ala., is building a steel steam tug, 98 feet between perpendiculars, 107 feet overall, with 21-foot beam, for the Gulf Barge Navigation & Towing Company, New Orleans, La. Latest compound type engines developing 400 horsepower will be installed.

Howard Shipyards & Dock Company, Jeffersonville, Ind., has received a contract for building ten oil barges for river service. Barges will be of wood, 130 by 25 by 7 feet 3 inches, without power; oil will be carried in bulk in the hulls.

R. & W. Hawthorn, Leslie & Company, Hebburn-on-Tyne, England, has received a contract from the Cunard Steamship Company for the building of a large steamer. Engines will be constructed at the St. Peter's works of the firm.

The Kawasaka Dock Yard Company, Japan, it is reported, has received a contract to build three passenger steamers for the Nippon Yusen Kaisha.

Kruse & Banks Shipbuilding Company, North Bend, Ore., has received a contract for building a lumber schooner for a San Francisco company. The vessel will be 240 feet long, 44-foot beam, and have a capacity for 1,000,000 feet of lumber.

Leathem & Smith Towing & Wrecking Company, Sturgeon Bay, Wis., is working on twelve 100-foot tugs for the Shipping Board.

Mitsui Bishi Company, Japan, it is reported, has received a contract to build three passenger steamers for the Nippon Yusen Kaisha.

The National Shipbuilding Company, 42 Broadway, New York, it is reported, has received a contract to build three 6,500-ton steamships for French owners. The ships will probably be built at the Three Rivers yard.

The Newburgh Shipyards, Inc., Newburgh, N. Y., has received a contract to build a freight steamer for the Union Sulphur Company, 17 Battery Place, New York.

The Puget Sound Navy Yard, Bremerton, Wash., has received a contract to build a 484-foot repair ship to cost about $3,000,000.

The United States Shipping Board has decided to build a considerable number of motorships of 8,000 tons deadweight.

NEW SHIPYARDS AND SHIPYARD EXTENSIONS

Blacksmith and Coppersmith Shops, Philadelphia, Pa.—William Cramp & Sons Ship & Engine Building Company, Beach and Ball streets, Philadelphia, Pa., is rebuilding blacksmith and coppersmith shops previously destroyed by fire. Four 15-ton cranes are being installed at the plant.

Boiler Plant, Hampton Roads, Va.—At the Hampton Roads Naval Base, Old Point Comfort, Va., the Navy Department will erect a $280,000 boiler plant. Contract tentatively awarded to Wise & Granite Construction Company, Inc.

Drydock, St. Helen's, Ore.—St. Helen's Shipbuilding Company is planning to build a 5,000-ton capacity drydock, 320 feet long by 90 feet wide.

Drydock, Repair Plant, Seattle, Wash.—The Lake Union Dry Dock & Machine Works plans to erect a 1,000-foot drydock, machine shop and oil station on a $30,000 tract of land on Lake Union. Improvements will cost about $50,000.

Drydock, Charleston, S. C.—At the Charleston Navy Yard, Charleston, S. C., the Navy Department will construct a $3,500,000 drydock, for which bids were closed on May 19. Work involves excavation work, installation of piping, erection of bulkhead, cofferdam and temporary structures, building drydock proper. The latter will consist of 180,000 cubic yards concrete, pump well, suction chamber, railroad tracks, crane tracks, culverts and sluices, with hydraulically-operated valves, keel blocks, bilge blocks, etc.

Drydock, Mobile, Ala.—W. T. Donnelly, 17 Battery Place, New York, will supervise the building of a 10,000-ton drydock. A ship repair plant, including boiler shops, blacksmith shops, machine shops and foundries, will be built in connection with the project.

Drydock, Galveston, Tex.—W. T. Donnelly, 17 Battery Place, New York, will supervise the building of a 10,000-ton drydock. A ship repair plant, including boiler shops, blacksmith shops, machine shops and foundries, will be built in connection with the project.

Drydock, Los Angeles, Cal.—The Los Angeles Shipbuilding & Dry Dock Company, Los Angeles, Cal., began construction on May 7 on a 10,000-ton drydock to cost $2,000,000.

Drydock, New Orleans, La.—W. T. Donnelly, 17 Battery Place, New York, will supervise the building of a 10,000-ton drydock. A ship repair plant, including boiler shops, blacksmith shops, machine shops and foundries, will be built in connection with the project.

Drydock, St. John, N. B.—Carlo Carneile, marine contractor, Montreal, Canada, has received a contract to build a 1,180-foot drydock at St. John, N. B., to be known as the Courtney Bay Drydock.

Drydock, Seattle, Wash.—The Ames Shipbuilding & Dry Dock Company has commenced construction on its six-pontoon drydock of 18,000 tons. C. A. Barron is the purchasing agent.

Drydock, Green Bay, Wis.—Carl Hartmann Company, Green Bay, Wis., has begun construction on the 600-foot concrete drydock. With the exception of keel blocks, reinforced concrete will be used throughout; capacity, 6,000 tons; made in four units, each unit constructed in three sections, 80 by 50 feet. Centralized pumping arrangement; individual pumping units for operation of separate units. Francis H. Early, architect, Chicago, Ill., and E. T. Morrison, Morrison & Beck, Chicago, Ill., are in charge of the work.

Drydock, Perth Amboy, N. J.—The Perth Amboy Dry Dock Company, Perth Amboy, N. J., is repairing and enlarging one of its drydocks upon which new pumping machinery will be installed.

Machinery and Equipment, Gulfport, Miss.—The International Ship Building Company, Gulfport, Miss., has increased its capital from $200,000 to $1,000,000. The company will enlarge its present plant with additional machinery and equipment.

Marine Railway, La Playa, Cal.—The Danforth Company, Buffalo, N. Y., holds a contract for building a drydock at La Playa, Cal., coaling station to cost $250,000. A well-equipped machine shop will be constructed.

Marine Railway, Wilmington, N. C.—The Hamme Marine Railway, 106 North Fourth street, Wilmington, N. C., R. F. Hamme president, will construct a 500-ton marine railway to cost $15,000 on a 100-foot waterfront. Electrical machinery will be installed.

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Naval Base, Havana, Cuba—Capt. Sidney Henry, United States naval engineer, has submitted plans to President Menocal, Cuba, for the erection of a naval shipyard on site opposite the capital. Plans include three marine railways and two concrete piers, etc. Monks & Johnson, 78 Devonshire street, Boston, has received the contract to build the naval base at an estimated cost of $5,000,000.

Ship Repair Plant, Houghton, Wash.—J. L. Anderson, of the Anderson Shipbuilding Company, has announced that the present Lake Washington yard will be converted into a repair plant. Construction includes new marine railway with capacity of 4,000 to 5,000 tons.

Ship Repair Plant, Lake Washington Canal, Wash.—Olson & Sunde, Lake Washington Canal, Wash., are building a new ship repair plant, including marine ways on Lake Washington Canal; machine shop now completed; work progressing on marine ways. Company will also manufacture marine equipment.

Ship Repair Plant, San Francisco, Cal.—D. A. Dickie, San Francisco, district manager of the United States Shipping Board, proposes using the Government Island concrete shipbuilding plant as a repair base for the merchant fleet. Proposed construction would cost $2,500,000, including the building of a floating drydock at a cost of $1,000,000.

Shipways, Portland, Ore.—The Marine Repair & Construction Company, Portland, Ore., will construct five new ways at the present repair plant to accommodate 200-foot vessels. New repair shops will be built.

Shipyard Extension, New Glasgow, N. S.—The Nova Scotia Shipbuilding Company, New Glasgow, N. S., has extended its shipbuilding plant.

Shipyard, San Diego, Cal.—The San Diego Shipbuilding Company, San Diego, Cal., a newly-organized concern, will build a shipbuilding plant on 17 acres of waterfront. Adam F. Weckler, president and general manager; Adam J. Weckler, treasurer; O. Winfield Wilson, secretary, and O. K. Wilson, vice-president and manager in charge of construction.

Structural Shop, Mare Island, Cal.—Contract has been let to the American Bridge Company, Wilkins building, Washington, D. C., for steel for structural shop to be built at the California Navy Yard. Cost of material, $591,181.

PROPOSED CONSTRUCTION

Dredging, New Haven, Conn.—The United States Engineer Office, New London, Conn., opened bids on May 20 for dredging at New Haven harbor.

Derrick Boat, Washington, D. C.—The Columbia Granite & Dredging Company, 3036 K street, N. W., Washington, D. C., is in the market for a derrick-boat to operate a clam-shell bucket for unloading sand and crushed stone.

Elevator Shaft, Philadelphia, Pa.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has invited bids for the building of an elevator shaft in the heavy machine shop at Philadelphia, Pa. Estimated cost $14,000.

Fill, Astoria, Ore.—New bids have been asked for making the fill in Astoria's third reclamation district. Estimated cost of work $257,000. R. R. Bartlett, city engineer.

Fireboat, Norfolk, Va.—Charles S. McLean, 412 Citizens Bank building, Norfolk, Va., is in the market for a fireboat.

Freight Shed, Astoria, Ore.—Bids were opened on April 29 for the building of a freight shed on Pier 1, 312 feet long and 92 feet wide. R. R. Bartlett, city engineer.

Harbor Improvements, Los Angeles, Cal.—The city of Los Angeles, Cal., has voted to spend $1,500,000 for harbor improvements.

Jetty and Revetment, Miami, Fla.—United States Engineer Office, Jacksonville, Fla., has opened proposals for a jetty and revetment construction in Miami harbor.

Lock and Dam, Cincinnati, Ohio—Capt. R. R. Jones, engineer in charge of Cincinnati District No. 1, has received a bid from the Dravo Contracting Company, Pittsburgh, Pa., for the construction of lock and dam No. 32 at the cost of $1,251,680.05.

Lumber Assembling Dock, Vancouver, B. C.—The Dominion Government, Ottawa, is preparing plans through the Department of Public Works, Ottawa, for a lumber assembling dock. The project will cost about $1,000,000.

Oil-Loading Docks, Freeport, Tex.—The Gulf Pipe Line Company, Freeport, Tex., is planning to operate oil-loading docks on a 333-foot waterfront.

Oil Storage Warehouses, Boston, Philadelphia, Galveston, Colon and Cristobal.—The United States Shipping Board plans the building of oil storage facilities at these ports to cost about $5,000,000.

Piers, Hoboken, N. J.—It is proposed to rebuild wooden Piers 6 and 3, recently purchased by the Government, with a third pier at the cost of $2,500,000. Construction to be modern, double-deck concrete and steel.

Pier and Freight Shed, Astoria, Ore.—Bids will be advertised about June 1 for building of reinforced concrete pier and freight shed at Astoria, Ore., to cost about $800,000. The shed will have reinforced concrete walls and concrete and bitulithic floors, will be 1,500 feet long and 160 feet wide, and be equipped with sprinkler system, cargo cranes, electric tractors and freight-handling apparatus. R. R. Bartlett, city engineer.

Piers, Milwaukee, Wis.—Under supervision of H. McL. Harding, the city of Milwaukee is planning the construction of municipal docks and piers. Concrete capped retaining wall will be built. Improvements include tracks for gantry cranes, a warehouse for each section, railroad tracks, etc.

Piers, Warehouses, Savannah, Ga.—The city proposes to build two piers, 1,500 feet in length, of fireproof, durable construction, with adjacent warehouses. Project will cost about $5,000,000.

Piers, Staten Island, N. Y.—The sinking fund committee of the New York Board of Estimate has voted to endorse the resolution authorizing the city to acquire 8,900 linear feet of waterfront at Staten Island. A preliminary appropriation of $3,000,000 was granted. Construction will include twelve piers, 1,000 feet long by 125 wide, with a water space of 300 feet between piers. Depth of water at piers will be dredged to 44 feet. Estimated cost $10,000,000.

Pleasure Pier, Redondo Beach, Cal.—The city of Rendondo Beach, Cal., has voted on bond for $40,000 for building a reinforced concrete pleasure pier. Leeds & Barnard, Los Angeles, Cal., are the engineers.

Ship Coaling Dock, New Orleans, La.—J. D. O'Reilly, chief engineer of the Dock Board, New Orleans, La., is preparing plans for a $390,000 ship coaling dock on a 1,200-foot waterfront. Project includes an 85- by 580-foot storage shed, with a capacity of 25,000 tons and a wharf 300 by 40 feet. A conveyor system, a 50-foot wharf tower, a 50-ton hopper, a stiff-leg derrick, derrick track hopper, 35 by 50 feet, bucket elevator, with a capacity of 200 tons hourly, self-recording and automatic scales, loading devices, etc., are to be installed.

Terminal Sales Building, London, England—Irving T. Bush, president of the Bush Terminal Company, New York, it is reported, is arranging for the construction of a large terminal sales building in London.

Timber Wharf—A. E. Foreman, Victoria engineer, Victoria, B. C., is soliciting bids for a timber wharf to be built at Prince Rupert, B. C., to cost about $47,200.

Wharf, Buena Ventura, Colombia, S. A.—The Departmento del Valle of the Republic of Colombia, S. A., has obtained a credit for $1,000,000, which will be used for the construction of a wharf at Buena Ventura, an important Colombian port on the Pacific coast.

Wharf, Seattle, Wash.—Mitsui & Company, San Francisco, Cal., is preparing to construct a 1,000-foot wharf at Seattle; also large tanks and a seven-story warehouse for storage of Oriental vegetable oils.

Wharf and Oil Station, Empire, Ore.—James S. Polhemus, United States Engineer Office, Portland, Ore., has completed plans for the construction of a 200-foot wharf and oil station to cost about $50,000 at Empire, Ore.

Watertank and Tower, Hampton Roads, Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning to build a steel watertank and tower at Hampton Roads, Va., to cost about $25,000.

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CONTRACTS LET FOR HARBOR IMPROVEMENTS

Dock, Astoria, Ore.—The Portland Bridge & Building Company, Portland, Ore., is constructing a 200- by 40-foot dock for the Standard Oil Company. Contracts for pump house, storage tanks, offices and warehouses have not been let.

Dredging, Tillamook, Ore.—The Tillamook Port Commission, Tillamook, Ore., has let a contract to the Tacoma Dredging Company, Tacoma, Wash., for removing 1,000,000 cubic yards of material to provide a mean harbor depth of 20 feet.

Power Plant Improvements, Naval Aviation Air Station, Pensacola, Fla.—Contract has been let by the Bureau of Yards and Docks, Navy Department, Washington, D. C., to the Carroll Electric Company, 714 Twelfth street, Washington, D. C., for $54,500.

Pier, Portland, Ore.—Contract has been awarded to Elliott & Scoggins for construction of a 300-foot addition to Pier No. 1 at St. John's Terminal and construction of wharf of Pier No. 2, to cost $329,279.20.

Warehouses, Port Clinton, Ohio—Cleveland Construction Company, Citizens building, Cleveland, Ohio, has received a contract to build warehouses at Port Clinton, Ohio.

EQUIPMENT

Boilers, Portland, Ore.—The Willamette Iron & Steel Company, Portland, Ore., has received a contract to furnish four boilers for 8,800-ton steamers being built by the Emergency Fleet Corporation in Shanghai, China, also orders for twelve boilers from the Robert Dollar Steamship Company.

Cranes, Charleston, W. Va.—The Bureau of Yards and Docks, Navy Department, Washington, has opened bids on twenty-two cranes to be installed at the naval ordnance plant. Requirements are as follows: One 250-ton, two 200-ton, one 125-ton, two 100-ton, one 75-ton, one 25-ton, two 15-ton; also two 250-ton and one 75-ton for use in connection with hydraulic presses, as well as eight 75-ton and one 150-ton, to be used in the machine shop and heat treatment department. About $1,805,000 is involved in the order.

Engine Lathes, Brooklyn, N. Y.—New York Navy Yard will purchase twelve 16-inch engine lathes. Bids received by the Navy Department, Washington, D. C.

Machine Tools, Hog Island, Pa.—The American International Shipbuilding Corporation, Hog Island, Pa., is in the market for 400 tools as follows: One hundred 9-inch or 14-inch shapers, 100 16-inch lathes, 100 20-inch upright drills and 100 10-inch grinders—and 100 electric motors for machine shops on merchant ships.

Machine Tools, Bristol, Pa.—The Merchant Shipbuilding Corporation, Bristol, Pa., is reported to be in the market for thirty sets of machine tools, as per specification under *Machine Tools*, Hog Island.

Propelling Turbines and Reduction Gears—Bids were opened on May 12 by the Purchasing Branch, Supply Division, Emergency Fleet Corporation, 140 North Broad street, Philadelphia, Pa., for furnishing 12,000-horsepower propelling turbines and reduction gears.

RECENT LAUNCHINGS

The Albina Engine & Machine Works, Inc., Portland, Ore., launched the 3,800-ton hull *Glymont* on April 23.

The American International Shipbuilding Corporation, Hog Island, Pa., launched its twenty-second ship, the *Satarita*, a 7,500-ton cargo carrier, on April 12, the *Kisacoquillas* on April 16, the *Schroon* on April 23, and the twenty-fifth ship on April 25.

The Ames Shipbuilding & Dry Dock Company, Seattle, Wash., launched another steel ship, the *West Islay*, on April 26, for the United States Shipping Board.

The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., has recently launched the following ships: (Fore River) the destroyer *Morris* on April 12, the Submarine R-3 on April 17, the destroyer *Tingey* on April 24, and the steamer *Andria Luckenbach* for the Luckenbach Steamship Company on May 3; (Potrero) the 10,100-ton tanker *Dorches*, the destroyer Howard on April 25, and the destroyer *Nicholas*, on April 12.

The Boston Navy Yard, Boston, Mass., launched the oil carrier *Brazos* of 14,500 tons on May 1.

The Brunswick Shipbuilding Company, Brunswick, Ga., launched the schooner *Eleanor Taylor* on April 30.

The Coast Shipbuilding Company, Portland, Ore., launched the hull of the *Boyton* on April 20.

The Frances Cobb Shipbuilding Company, Rockland, Me., launched the four-masted schooner *Freeman*, which it is building for the Atlantic Coast Company, Boston, on April 3.

The Columbia Shipbuilding Corporation, Portland, Ore., launched the 8,800-ton steamer *West Hargrave* on April 10, the *West Quechee* on April 18, the *West Harlan* on May 3, and the *City of Eureka* on May 8.

The Coos Bay Shipbuilding Company, Marshfield, Ore., has launched the eighth Ferris type vessel, the *Peishewan*, which the company is building for the Government.

The William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., recently launched the torpedo boat destroyer *Southard* and the destroyer *Hovey* on April 26.

The G. G. Deering Company, Bath, Me., launched the 255-foot five-mast schooner *Carroll A. Deering* on April 4.

The J. F. Duthie & Company, Seattle, Wash., launched the 8,800-ton steel ship *West Hematite* on April 26 for the United States Shipping Board.

The Federal Shipbuilding Company, Kearny, N. J., launched its thirteenth steel ship, the *Lorain*, a 9,600-ton vessel, on April 17.

The Fougner Concrete Shipbuilding Company, Inc., Long Island, N. Y., has launched the 3,500-ton concrete ship *Polias*.

The Foundation Company, 233 Broadway, New York, launched its fifteenth vessel on May 3, at the Savannah yards.

The Fulton Shipbuilding Company, Wilmington, Cal., launched the 3,500-ton wooden ship *Woboka* on April 15.

The Gildersleeve Ship Construction Company, Gildersleeve, Conn., has launched the third and last 1,000-ton coal barge which the company is building for the Government. These barges are built at a cost of $35,000 each, and are delivered at the New York Navy Yard, Brooklyn, N. Y.

The Gray's Harbor Motorship Corporation, Aberdeen, Wash., launched the 4,000-ton twin-screw steamer *Gray Cloud* on April 12, building for the Emergency Fleet Corporation.

The Merrill-Stevens Shipbuilding Corporation, Jacksonville, Fla., launched the Emergency Fleet Corporation's vessel *Lone Star* on April 10. The vessel was being repaired at the company's drydock.

The McAteer Ship Building Company, Seattle, Wash., launched the 2,500-ton schooner *Mount Whitney* on April 17.

The Moore Shipbuilding Company, Oakland, Cal., launched two 9,400-ton freighters, the *Nokatay* and *Nockum*, also the 10,000-ton tanker *Miskianza* on April 27.

The J. M. Murdock Shipbuilding Company, Jacksonville, Fla., launched the 3,500-ton Ferris vessel *Fort Lauderdale* on April 10.

The Murnan Shipbuilding Corporation, Mobile, Ala., launched the fourth of twenty barges which the company is building for the Warrior river service on April 22, and two mud scows were launched on April 30.

The National Ship Building Company, Orange, Tex., launched the wooden vessel *Argena* on April 15.

The Newburgh Shipyards, Inc., Newburgh, N. Y., recently launched the 9,000-ton steel freight steamship *Gold Spring*.

The New York Shipbuilding Corporation, Camden, N. J., recently launched the destroyer *Brooks*, and on May 8 launched the destroyer *Herbert*.

The Nicholas Tsu Shipbuilding Works, Shanghai, China, launched the 260-foot vessel *Gweneth* on March 2.

The Nilson & Kelez Shipbuilding Corporation, Seattle, Wash., on April 28, launched the 3,500-ton Ferris type wooden vessel *Cinyras* for the United States Shipping Board.

The Northwest Steel Company, Portland, Ore., launched the 8,800-ton steel vessel *Tripp* on April 23, and the *West Chatala* on May 3.

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The Pacific Coast Shipbuilding Company, Suisin Bay, Cal., launched the 9,400-ton deadweight freight steamer *Cockaponset* on May 4. This is the third vessel of that size which has been built at that yard.

The Portland Shipbuilding Company, Portland, Ore., is about ready to launch a powerful sternwheel towboat, to be named the *Portland*, which is being built by the Portland Commission for river and harbor towing.

The St. Helen's Shipbuilding Company, Portland, Ore., launched the barge *Fort Shaw* on April 19.

The St. John's River Shipbuilding Company, South Jacksonville, Fla., has launched the 3,500-ton Ferris type vessel *Fort Pierce*, and is now building three large barges.

Sanderson & Porter, Raymond, Wash., launched the *Kitan* on April 1. The vessel will be outfitted at the Griffith's plant, Winslow.

The Sandy Point Shipbuilding Corporation, Sandy Point, Md., launched the 3,500-ton Ferris vessel, *Waukomis*, on April 12.

The Seaborn Shipyards Company, Tacoma, Wash., launched the 3,500-ton wooden vessel *Chesterfield* on April 17.

The L. H. Shattuck, Inc., Shipyard, Portsmouth, N. H., launched the Ferris type wooden vessel *Sylvanus* on April 14.

The Skinner & Eddy Corporation, Seattle, Wash., launched the 9,600-ton steel ship *Polybius* on April 12, and its thirty-seventh vessel the 9,600-ton *Edgewood* on April 19.

The Sloan Shipyards Corporation, Olympia, Wash., launched the 3,500-ton Ferris type wooden vessel *Hyannis* on April 14 for the Emergency Fleet Corporation.

The Southwestern Shipbuilding Company, San Pedro, Calif., launched the 8,800-ton steel freighter *West Cawthon*, on April 16.

The Standard Shipbuilding Company, Shooters Island, N. Y., launched the 7,500-ton steel cargo ship the *Glenridge* on April 20.

The G. M. Standifer Construction Corporation, Portland, Ore., launched the steamer *Akanaquent* on April 17, and the *Kudapasan* on May 3; (Vancouver, Wash.) the 9,500-ton steamer *Waban* on April 17, and the *Bushrod* on April 28.

The Supple-Ballin Shipbuilding Corporation, Portland, Ore., launched the composite ship *Dertona* on April 10.

The Tacoma Shipbuilding Company, Tacoma, Wash., launched a 3,500-ton steamer, the *Fort Union*, on April 17.

The Texas Steamship Company, Bath, Me., has launched the *Texaco*. The vessel will be used for coastwise service.

The Todd Dry Dock & Construction Corporation, Tacoma, Wash., launched the 7,500-ton steel ship *Remus* on April 16, and the 7,500-ton steamer *Ossining* on May 6.

The Union Construction Company, Oakland, Cal., launched the 9,400-ton *Hatchie* on April 26.

Changes in Shipping Board and Emergency Fleet Corporation

Henry M. Robinson, Pasadena, Cal., has been appointed a member of the Shipping Board to replace Charles R. Page, of San Francisco. Walter S. Reed, treasurer, will succeed George T. Smith; P. J. McAuliffe will succeed Daniel Cox, head of ship construction division; R. E. Talbert will succeed M. D. Ferris, head of contract division; Capt. R. E. Bakenhus, United States Navy, will succeed Admiral H. H. Rousseau, head of the shipyard plants division; M. H. S. Rollason will succeed A. E. Pfeiffer, head of the material supplies department. No reports have been received as to the successors of Gordon Wilson, general auditor, and R. W. Leatherbee, head of the industrial relations division. S. M. Evans, Orange, N. J., will succeed Howard Coonley.

PERSONALS

Homer L. Ferguson, president and general manager of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has been elected president of the Chamber of Commerce of the United States. Mr. Ferguson has recently been nominated for membership on the Council of the National Merchant Marine Association.

H. McL. Harding has been retained by the city of Milwaukee, Wis., as consulting and supervising engineer, in charge of construction on the proposed municipal docks and freight terminals to be erected on Jones Island.

Lieutenant-Commander G. A. Duncan, Civil Engineer Corps, United States Navy, formerly resident engineer at the Emergency Fleet Corporation's plant at Newark Bay, N. J., is now public works officer in charge of the construction work at the Naval Operating Base situated at Hampton Roads, Va.

L. W. Hertz, formerly with Moore & McCormack Company, is now vice-president and general manager of the National Steamship Lines, Ltd., 11 Broadway, New York city.

E. O. Cutler, vice-president and manager of the Groton Iron Works, Groton, Conn., has resigned from the company so that the receivers will not feel restrained in any of their actions in connection with the conduct of the company. Mr. Cutler still retains his position as vice-president and consulting engineer of the Virginia Shipbuilding Corporation, Alexandria, Va.

H. E. Frick, who has acted as the United States Shipping Board Emergency Fleet Corporation representative at the Hog Island shipyard, has been appointed district manager of the Shipping Board in Seattle, Wash.

T. M. Cornbrooks, who for the past nineteen years has been connected with the Sparrow's Point, Md., plant now operated by the Bethlehem Shipbuilding Corporation, has resigned his position as assistant manager at that yard to take the position of general superintendent of hull construction in the yards of the New York Shipbuilding Corporation, Camden, N. J.

Andrew V. Terek, recently discharged from the Naval Aviation Service, has returned as master mechanic in charge of the up-keep of the factory of the Bantam Ball Bearing Company, Bantam, Conn.

Galin L. Stone, who has acted as president of the Atlantic, Gulf & West Indies Steamship Lines, has been elected chairman of the board, and Alexander R. Nicol, former treasurer of the allied companies, has been elected president.

G. A. Tomlinson has resigned as director of the Inland Waterways and Canals Division, which is under the jurisdiction of the United States Railroad Administration, to become resident director of the London office of the American Shipbuilding Company.

Capt. William Magee, manager of the North Pacific district of the Emergency Fleet Corporation on the retirement of Capt. Blain, has resigned to become connected with the Marine Construction & Repair Plant, Eagle Harbor, Wash.

On May 16, Benjamin G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., was awarded the Edison Medal by the American Institute of Electrical Engineers "for invention and development of machinery."

Oliver P. Caldwell has resigned as vice-president and director of the United States Navigation Company.

Capt. F. W. Cullum, formerly master on the Blue Funnel Lines, Liverpool, England, has joined the organization of Capt. John F. Blain, Seattle, Wash., as marine surveyor.

R. E. McMath has been elected secretary of the Bethlehem Shipbuilding Corporation and the Bethlehem Steel Company, Bethlehem, Pa.

Daniel H. Cox, having resigned his position as manager of the Ship Construction Division of the United States Shipping Board Emergency Fleet Corporation, has resumed his original business with the firm of Cox & Stevens, naval architects, marine engineers and vessel brokers, 15 William street, New York city.

Charles H. Stoddard, who for three years has been chief engineer of the Moore & Scott Iron Works, San Francisco, Cal., has been appointed consulting marine engineer of the Heine Safety Boiler Company, manufacturers of Heine watertube boilers, with plants located at St. Louis, Mo., and Phœnixville, Pa. Mr. Stoddard, who received his technical education at Stamford University, has had extensive experience in the designing of a great variety of machinery and vessels on the Pacific Coast, including boilers of all types, engines, steamers, tugboats, standard wheel and sidewheel river boats, war ships and cargo vessels.

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